SCIENCE

FRIDAY, JANUARY 3, 1913

CONTENTS

The American Association for the Advancement of Science:—
Some of the Next Steps in Botanical Science: PROFESSOR CHARLES E. BESSEY 1

Recent Explorations in Siberia: DR. A. HRDLIČKA 13

The Reorganization of the Medical Department of the University of California 14

Scientific Notes and News 14

University and Educational News 18

Discussion and Correspondence:—
A New Weed Exterminator: PROFESSOR J. C. ARTHUR. *Greek Refinements in Architecture:* DR. EDWARD S. HOLDEN. *The Question of the Older and Newer Appalachians:* PROFESSOR B. K. EMERSON 19

Scientific Books:—
Dakin on Oxidations and Reductions in the Animal Body: PROFESSOR LAFAYETTE B. MENDEL. *Walker on North American Dragon Flies:* PROFESSOR T. D. A. COCKERELL 21

Special Articles:—
A Preliminary Note on the Coagulation of Proteins by Ultraviolet Light: W. T. BOVIE 24

The Astronomical and Astrophysical Society of America: PHILIP FOX 25

Societies and Academies:—
The New Orleans Academy of Science: PROFESSOR R. S. COCKS 40

MSS. intended for publication and books, etc., intended for review should be sent to Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

SOME OF THE NEXT STEPS IN BOTANICAL SCIENCE[1]

WHEN one who has worked long in any field of science speaks before an audience such as this he is expected to say something about the condition of his branch of science when he began work with meager and poorly adapted apparatus, to contrast it with its greatly improved condition to-day, and to dwell with pride upon the finely equipped laboratories with costly apparatus especially designed for particular experiments, to be found by the twentieth century scientific student. And I must confess that the temptation to do so was one difficult to resist, for we who have grown old in years are fain to dwell upon the days of long ago with the garrulity which comes with gray heads and withering muscles. It has seemed to me wiser, however, that this evening we should look into the future rather than into the past, for in that direction lies the possibility of progress, and it is of progress that I wish to speak.

THE BOTANY OF YESTERDAY

Yet in order that we may properly orient ourselves with reference to the area covered by the science of botany to-day, we shall have to go back a few decades to understand what additions have been made to its territory during this period of expansion. For the shrewd observer can not avoid the conclusion that botany has shared with the world powers in a territorial growth which has extended its boundaries far beyond those known to the fathers, and

[1] Address of the president of the American Association for the Advancement of Science, Cleveland, December, 1912.

we have annexed much contiguous and even some remote territory in a most imperialistic fashion. It may be comforting to some people to know that during all this time there have been those who have constantly and consistently lifted up their voices in protest against this contravention of the practise of the fathers, and the breaking down and removal of the ancient landmarks. In all these years there have been botanical anti-expansionists, but like their brothers in the national field they have been overwhelmed, and the tide of expansion has swept on unchecked.

Consider for a few minutes the botany of forty years ago, when you could count on the fingers of one hand the American colleges that had chairs of botany. And here I use the term chair advisedly, for they were literally chairs and not departments, much less laboratories. And everywhere else in the colleges of the country the chairs of botany were represented by what Holmes so aptly called "settees" from the number of subjects taught therefrom. The botany dispensed from these chairs was the delightful study of the external morphology of the higher plants, especial emphasis being laid upon the structure of flowers and fruits. And it may truly be said here that often the teaching was done very well, far better than many a botanist to-day is wont to imagine. I am pretty sure that in general the teaching was as successfully done then as it is now. There were some poor teachers then as there are now, and there were some inspiring teachers then who touched their pupils with the sacred fire, as there are now some who have had a divine call to teach and inspire and help.

And with this external morphology there was always associated the classification of the higher plants, in its simpler form the pleasurable pastime of identifying the plants of the neighborhood, and in its more advanced form represented by the work of Torrey and Gray and Vasey and Engelmann. And we should judge the systematic botany of that day by the work of these masters and not by the diversions of its amateurs; and you will agree with me that so judged the systematic botany of that period will not fall short of any standard we have set up in these later days.

The botany of that day was not without its laborious investigations and its tangible results. Every new area was a great out-of-doors laboratory to be diligently studied from border to border. That was the day of the founding of many small botanical gardens, and small local herbaria, some of which having served their purpose disappeared long since, while others have grown into the great and flourishing institutions of to-day.

This much as to the botany of the immediate past; the phase of the science in which the older living botanists were trained.

PRESENT-DAY BOTANY

And what of the botany of to-day? Let us consider for a little the present condition of the science.

It is Unorganized.—The personnel of botany has greatly increased with the great increase in the territory it now includes. This personnel, it must be said, is still quite heterogeneous. Some of us are largely self-taught, so far as the major part of the subject is concerned. We brought to our work the results of the meager teaching of the old-time college class-rooms, and year by year we have enlarged the borders of our own departments as we have added to our own knowledge of the subject by means of our laboratories and libraries. Thus we have built all kinds of superstructures upon the foundations supplied by our teachers. As a consequence the science is yet largely unorganized and lacks consistency in plan and

purpose. Here and there a dominant man has wrought out a scheme of the science for himself, but how familiar is the fact to all of us that there is yet no agreement even upon so small a question as to the content of the first year of college botany, or the mode of its presentation. There is moreover a vagueness as to the boundaries of the science, some botanical teachers wandering far across the border into the domain of some contiguous science, or still more commonly into the more or less practical applications of some portions of botany. This latter indiscretion is especially noticeable in the textbooks prepared for the secondary schools, in some instances by botanists of good standing. If this were done by the agriculturists, the agronomists, the horticulturists, the foresters and others in similar lines of work with plants, it would not be surprising, but when this is done by botanists it is significant of the unorganized condition of the science. With a fuller knowledge of the science there must come a clearer vision of what it is, and what it is not, and we shall no longer find textbooks of botany made to include so much that is not botany, while leaving out so much that is botany.

This difference of opinion as to what constitutes botany results in the absence of united effort. In its simplest aspect it takes the familiar form of uncertainty as to the content and value of the work done by the student elsewhere when he transfers himself from one college to another. As a matter of fact there is yet no agreement as to what is a standard first-year's course in college botany. What teacher has not been sorely puzzled to know to what courses to admit men who came from another college with credits in botany! It is quite unscientific to try to account for this condition by an excusatory reference to the individual peculiarities and the personal differences of the teachers. In science we consider the personal equation as something to be determined and eliminated, and not to be excused and tolerated. Every difference in the treatment of, say the first-year course, is just so far an indication of a more or less unscientific attitude by one or all of the teachers concerned. We work in this haphazard, disconnected way either because we do not know any better, or knowing better we think it not worth while. Either horn of this dilemma is equally unworthy of our acceptance. Ignorance is no valid excuse for the scientific man, and in science everything is worth while. It is to our shame as botanists that we acknowledge our inability hitherto to frame a standard first-year course in college botany. When the science is definitely formulated in the minds of botanists the present disagreement will no longer exist. Surely we now "see as through a glass darkly."

The Applications of Botany.—Again, it may be remarked that we are to-day placing great emphasis upon the applications of botany to some of the great human activities, especially to agriculture. Witness the agricultural experiment stations with their botanists of all kinds, from those who study weeds and poisonous plants, to the physiologists, pathologists, ecologists and plant breeders. And as we look over the work they do we are filled with admiration and pride that they have individually done so well. But it is not the cumulative work of an army of science, it is rather the disconnected, unrelated work of so many individuals. They are doing scientific work in an unscientific way. There is as yet no movement of a united army of science; it has been rather a sort of guerrilla warfare against the common enemy. We lack organization, and like unorganized soldiers we make little headway in spite of

individual learning and efficiency. Botanical science which should have guided and directed these laudable applications has not kept pace with them, and we have the spectacle of these economic botanists, physiologists, pathologists, plant breeders and others working apart from the botanists proper, and sometimes even disclaiming any allegiance to the parent science. Nothing but confusion and disaster can result from such a condition.

Lack of Cooperation.—Contrary to what is sometimes affirmed, botanists are still studying the flora of the country. In some quarters there has been expressed the fear that field botany has disappeared from the schools and colleges; but this is far from true. While it no longer claims the larger part of the student's attention, it is still an essential part of the training of every botanist, and it is probably true that in some cases there is even more field work required to-day of young botanists than its importance demands. Certainly in one kind of field work I should like to see some of the energy and ability now given to the discovery of means for splitting old species turned towards the solution of problems pertaining to growth, and development, and reproduction. But the careful field study of what plants grow here and there, and why they do so, is greatly to be commended. The sociology of plants, or as we call it, ecology, has given in the last few years a new reason, as well as a new direction to field botany.

The systematic botany of to-day continues to concern itself more with the distinction of species than with their origin, and this has brought to this department of the science an increased narrowness which has greatly injured its usefulness. On the other hand plant breeding, which should be the experimental phase of systematic botany, has had no connection with it. And strangely, systematic botany, which should welcome plant breeding as an ally in its quest as to the meaning and origin of species, has been scarcely at all interested. It has been left to the florists, the horticulturists and the agronomists to patronize the new phase of botany, and this they have done, in spite of the new and quite unnecessarily formidable terminology so rapidly developed by the breeders. So what might have proved to be one of the most helpful aids to the solution of the greatest of biological problems—how living things have come to be what they are—is allowed to fret out its life by beating vainly against the technical bars of its Mendelian cage. I know of no better illustration of the unorganized condition of botanical science than this failure of the systematic botanists and the plant breeders to work together for a common end.

THE BOTANY OF TO-MORROW

But I have dwelt enough upon the past and the present, and I feel inclined to apologize to you for having turned your faces so long backward. For while we must consider what has been, we can make progress only by planning for what is to be. So let us turn now to the future of botanical science, and endeavor to trace its more profitable course of development during the next one or two decades. What are seemingly to be the demands of modern society upon this science? What are to be some of the next steps in its evolution? For whatever we may say in regard to the independence of science we can not escape the fact that it must serve its "day and generation." No science can hope for support or recognition that does not respond to the demands of its age. And yet we must not ignore the labors of those pioneers in every science who foresee possibilities that are hidden from the mass of men.

There must always be place provided for the few seers who see to-day what is now hidden from mankind in general, and may continue to be so hidden for generations, or centuries. All honor to these prophets who prepare the way for the oncoming of scientific truth, but it is true, nevertheless, that it is only when such truth has permeated contemporary society that science thrives.

Its Content.—Looking forward, then, let us try to see the trend of that branch of science which deals with plants, the science which I have the honor of representing on this platform this evening. And my first inquiry may well concern itself with the content of botanical science in the immediate future. As we become better acquainted with it and recognize more clearly its relations to the activities of the community we shall be able to define its proper content with more accuracy. And let no man attempt to belittle the importance of such an undertaking. It is not useless to attempt to fix the boundaries of any field of human endeavor, especially in such a one as this which deals with so vast a number of individual objects, each having many possible relations to one another and to ourselves. I am well aware of the impossibility of absolutely delimiting botany from every other science, and especially of doing so with reference to many of its applications, and I am fuly aware of the fact that the limits of any science are subject to change with the progress of human knowledge. Now and then there must be a "rectification of the frontier" in respect to the boundaries of a science, as with the boundaries of a great empire, as its farther provinces and the exact location of rivers and mountain ranges become better known. So without doubt we shall have to add to or subtract from the area now allotted to botany; and yet I feel that it is worth our while to spend a little time in indicating its present boundaries and content.

With all the details that may be insisted upon by some specialists it still is true that the field of botany may be considered in three parts, structure, physiology and taxonomy. Beginning with such structures as are obvious to our unaided eyes we have carried our studies to the minute structure of the tissues, and the cells which compose them. We are able now to peer into the protoplasmic recesses of the living cell, and while we can not say that we have seen life, we have seen where life is, and what it does. Cytology, histology and morphology in our modern laboratories have greatly changed our conception of the structure of the plant. It is no longer made up of forms to be compared because of their general similarity of outline, or of position in the plant body. The plant as a whole is a community of variously differentiated living units, just as is each of its organs. It is a complex community in which there is a measure of individual independence of the units, along with much of mutual dependence.

This leads me easily to that portion of the field of botany that has to do with the activities of plants and their organs—physiology—whose scope has been so greatly extended in these later years. Here such inquiries as those pertaining to nutrition, growth, sensibility, reproduction are of primary importance. The introduction of the experimental method of inquiry has made this a favorite department of the science. Who does not enjoy catching a plant, tying it up in a corner and compelling it to do something, while we watch for the result? This kind of study appeals especially to those who are looking for demonstrations, and for this reason plant physiology has been increasingly popular. Some botanists indeed have gone so far as to insist upon

giving first place to physiology, probably because of its ready appeal to our senses. It is easy to interest a boy in the thing that responds, whether it be a kicking frog stimulated by an electrical discharge, or a green plant whose stimulation is a properly directed beam of sunlight. And yet it is well for us to remember that the plant is first of all a structure, whose complexity may well challenge the most acute minds. We find it far easier to record the responses of plants to our planned stimuli than to unravel a structural complex, and so no doubt we shall continue to entertain ourselves and our students with what are too often futile experiments.

In this part of the botanical field are pathology, which grew up from our observation that organs may not respond normally; ecology, which developed from the observation that plants tend to live in communities; and phytogeography, having to do with the means for and the results of distribution. There are signs that for economic reasons pathology may become rather sharply set off from physiology, of which it is properly a part, much as through the zeal and enthusiasm of the ecologists there was once the suggestion of a physiological schism. The latter is happily no longer imminent, and it may be hoped that it will not again threaten the unity of plant physiology. And so it may be hoped that the pathologists will not wholly secede from association with the physiologists.

Taxonomy, or as we used to call it, classification, occupying the third division of the field of botany, long received the almost exclusive attention of botanists. And even to-day it is the pretty general opinion of our non-botanical friends that we are constantly employed in collecting specimens, and in some intricate and mysterious way determining their classification and affixing to them their proper Latin names. And it must be admitted that every botanist does a good deal of just such work, quite as every chemist makes many analyses, and tries to arrange in orderly sequence the chemical substances which he has in his cabinet, and the astronomer classifies and names the heavenly bodies with which his science deals. At first even the botanists knew but few plants, just as now most men know scarcely more than a score. But as the botanists came to know a larger number of plants, it was imperative that they should be named, and then grouped conveniently for easier reference. Thus arose such crude, primitive classes as herbs, shrubs and trees, which served their purpose until the numbers became too great again, when additional structural differences were brought in to help separate the large numbers into smaller groups. This was the earlier classification, based upon structure alone. It was taxonomy without doubt, and it was helpful, since it enabled us to arrange plants in an orderly fashion, but it ignored the fact that plants have ancestors, and that the plants of to-day are what they are through their inheritance of ancestral characters, accompanied by modifications peculiar to them alone. When, however, the doctrine of evolution came into botany it brought with it the idea of descent, and thereafter taxonomy included phylogeny. To-day the taxonomist is no longer content to stop with a knowledge of the structural differences between plants; he must know how this structure arose from that; he must know which is the primitive structure and which the derived. Phylogeny has so far entered into taxonomy that it has given new meaning to the work of the systematic botanist, and it is bringing into this department of the science something of the philosophical aspect which was nearly

wanting heretofore. That this must be the direction of the development of the taxonomy of the future is without question, and we may look confidently for a marked expansion and enlargement of the phyletic idea in botanical taxonomy.

And here I may pause for a moment to advert to a part of taxonomy with which some biologists have little patience, without good reason, as it seems to me. I refer to the matter of taxonomic nomenclature which has vexed the souls of many botanists, especially during the past one or two decades. However, since every science must have its nomenclature it is childish for us to wish to ignore it in botany. It is a part of the science, and we must give it consideration if we are to do our full duty. I have been surprised many times when men have spoken disparagingly of the whole matter of nomenclature, and of those who are giving time and effort to its stabilization. While it may be granted that not every botanist is in duty bound to help to settle questions of nomenclature, or even to take part in framing the general rules of procedure, it is the duty of every one to appreciate and encourage those who are so engaged. It has sometimes seemed to me as I have heard wholesale denunciations of nomenclature and nomenclaturists that instead of being botanists we are only cytologists, morphologists, physiologists, pathologists, ecologists.

This contempt for nomenclatural questions is symptomatic of a much-to-be-deprecated state of mind, quite too common among scientific men, especially those who have engaged in special lines of work. I believe in specialization in botany, but specialization should not degenerate into narrow bigotry. A wise man long ago admonished his friends in words which I am tempted to repeat here as most fitting:

> But now they are many members, but one body. And the eye can not say to the hand "I have no need of thee"; or again the head to the feet, "I have no need of you." Nay, much rather, those members of the body which seem to be more feeble are necessary; and those parts of the body, which we think to be less honorable, upon these we bestow more abundant honor, and our uncomely parts have more abundant comeliness; whereas our comely parts have no need: but God tempered the body together, giving more abundant honor to that part which lacked, that there should be no schism in the body, but that the members should have the same care one for another.

Wiser words of counsel for the workers in different parts of the field of a science were never written, and I beseech you, my botanical brethren, to heed them, "that there should be no schism in the body" of botany.

Personality of the Botanist.—Quite easily the foregoing leads to a consideration of the personality of the botanist of the immediate future. What manner of man will he be? What will be his training? In other words, what will the future demand of the botanist? For it does not need argument to show that the men engaged in botanical work in the future will be developed and fashioned in response to the demands of the community.

If I interpret aright the movement of modern society as a whole, it is going to result in a demand for two things that by many are thought to be opposite and antagonistic—specialization and breadth. The first it will demand of its experts, the men who are set aside to solve particular problems for the community. In most cases these will be economic problems of immediate importance to the community, but there is no reason why in the most intelligent communities they should not be scientific problems, of more remote importance. No doubt there will be a demand for many such experts, each of whose tasks will be

restricted to but one problem. The only requirement laid upon these men will be that they can do the work to which they have been assigned, and the more restricted the problem the narrower may be the preparation of the expert. Such men will be demanded in increasing numbers by the scientific bureaus of the general government, by the state experiment stations and by large private establishments engaged in beet growing, cane growing, fruit growing, potato growing, hop growing, etc., and it will be the duty of the teachers of botany to produce an adequate supply of such botanical experts.

But while the community is certain to increase its demand for botanical experts we must not overlook the fact that with this demand will come another, much more imperative, for men of far greater breadth and depth of knowledge, who in addition to training the botanical experts of various kinds for the community, are able to bring the science as a whole before the youth of the land as a part of the scientific culture which modern society requires. These must be men of the broadest training; men whose sympathies are not bounded by the one science which they know, much less by one phase of botanical science; men who, knowing well their one science, know also much of the related sciences; men who in addition to a knowledge of science bring to their students and their community the results of that broader view which relates botany to the life and activities of the community. Such men bear the name of botanists worthily, and justify the contention of scientific men that science may contribute more than material good to the community. These are Lord Bacon's "Lamps," and "Interpreters of Nature."

And my vision is by no means unrealizable. Already among botanists there are those who measure up to this ideal. Already there are those who to a wide and deep knowledge of plants add that breadth of culture that brings them into sympathetic relations with the company of scholars throughout the world. As I speak these words there will come to you the names of those of our number who are known and honored as botanists, but whose beneficent influence extends far beyond the limits of their science. And I am confident that this high standard, now reached by some, will be demanded for all by the community of the future. Such botanists will be the leaders of their students, guiding wisely their early steps in science; they will be the leaders of the experts whose results they will be able to relate to other parts of the botanical field; and they will be the leaders of the community, not only in the applications of botany to the solution of material problems, but in a larger and nobler manner they will be able to help them in the higher things that make for culture and spiritual uplift.

The Teaching Institutions.—Turning now to the institutions of learning—the colleges and universities—where botany holds a place as one of the sciences, let us ask what we may look for in regard to its development. In every proper college the department of botany exists primarily for its teaching function, and this is true also for nearly every university. And while we may hope to make every such department a center of investigation also, it is true now, and it must always be true that in our educational institutions the teaching of the science must be the primary object of every one of its scientific departments. So the future will call for much more of definiteness as to the content and sequence of the science, as well as the manner of its presentation; its pedagogics, if you please.

The college and university departments of botany in the near future will arrive at

a clearer notion as to the essentials of the science as a subject of study. It seems to one who carefully looks over the field that there is often only the most vague notion of the relative importance of the known facts in regard to plants, those of trivial importance receiving as much weight, perhaps, as those of profound significance. Especially is this true of the more elementary courses, in which there is also the greatest diversity in the presentation of the subject matter. This condition argues incompleteness of knowledge either as to the science as a whole, or as to its pedagogics. We have all heard the excusatory remark that "it makes little difference how or where we begin the study of plants, and in what sequence we pursue it." Yet none of us would admit such a contention in regard to any other matter. The more we know of a country, the more definite are our ideas as to what are its more important mountains, rivers, cities and institutions, and it is these that we feel the traveler should see. We particularize when we know; we generalize, and are vague, when we do not. It should not be long until this vagueness and doubtfulness as to substance and manner in the presentation of botany in the high school, and in the college, and in the university, will be a thing of the past. In the near future we shall certainly have the lower work clearly defined, as it is in mathematics and language, and on this the higher work will be based, to the great saving of the time and energy of teacher and student, now needlessly wasted. And I appeal to you, botanists, to take up seriously the task of so arranging and coordinating our work that botany shall no longer suffer the reproach of being the most chaotic of the primary sciences. Do not tell me that we can not agree. *We must agree.* If we know our science sufficiently well we can easily discern the more important parts. Let him whose knowledge is too limited to enable him to see over the whole field step aside. Let him who has no adequate perception of the pedagogical aspects of the problem step aside. Then let the select few make a pronouncement, subject to periodical revision. This is the way that scientific men should settle the question. This is the way it will be settled some day, in the not very distant future.

The Botanical Stations.—But the college and university departments are by no means all that are engaged in botanical work. Within the past twenty-five years many stations have arisen in which botanical investigations are made. Under various local names they are in fact "investigation stations" and while their results have not been uniformly reliable it is a most hopeful sign of progress that they exist at all. Foremost among these are the fifty or more agricultural experiment stations to which I have already briefly referred, with assured support from the states and the national government for all time to come, in which botanical investigation forms no inconsiderable part of the work undertaken. Hampered as they generally were in their earlier years by incompetent direction, and often by still more incompetent workers, it is gratifying to know that year by year there has been marked improvement in both, and that now many of the directors are men of such scientific training that they wisely use the means at their disposal for investigations of permanent scientific value. And if I read aright the tendencies in these stations, it will not be long until their scientific output will be wholly reliable, as indeed it is now in some cases. This condition will be fully realized when these stations are wholly under the direction of men of broad scientific training.

And here again we have a duty to perform. We must recognize the agricultural

experiment stations as permanent parts of the botanical equipment of the country. They will be with us in the future, and their results will continue to be added to botanical knowledge. We must accept them as a part of our scientific equipment, and help to make them more efficient. It will not do for us to stand aloof, and decry their results as not accurate, and as agricultural instead of botanical. When we fully realize that we have in these experiment stations so many institutions of endowed research, we shall not hesitate to welcome them to the ranks of science. The fact that these researches in regard to plants so often have an economic purpose does not lessen the value of the results to the botanist of broad training and sympathies. Here again we must remember that as botanists we should not undervalue those contributions to knowledge in which we happen not to have an immediate interest. My scriptural quotation of a few minutes ago might well be repeated here: "the eye can not say to the hand 'I have no need of thee,' or again the head to the feet ' I have no need of you.' " When they receive the hearty cooperation of the botanists of the country the agricultural experiment stations will develop into centers of investigation of the greatest importance to science.

Already we have stations for the study of plants under particular environments, as our seaside stations, our mountain stations and a single desert station. I take it that these are suggestive of what are to come in the future. Instead of trying to make seaside conditions away from the sea, we go to the sea and there set up our laboratories. So when we want to know how plants behave in the desert we go to the desert. And this is no doubt to be the direction of botanical investigation. We are going to study plants under their natural environment, and to the seaside laboratories we shall add (as indeed we have already to a limited extent) lakeside laboratories, riverside laboratories, swamp laboratories, forest laboratories, field laboratories. Already the tropical laboratories, in Java, Ceylon and Jamaica have justified themselves, and no doubt to these we shall soon add arctic and tundra laboratories. All this signifies that more and more we are going to see what the plant is doing in its natural environment, and then we can undertake intelligently to watch it under a changed environment. So the future is to witness a great increase in the number of these laboratories, and how far it will go can only be conjectured. It now appears probable that eventually every botanical department will have one or more of these environmental laboratories in which work may be done by advanced students. They will take the students out of doors, as the old-time systematic botany took them out, but these students will go equipped with thermometers, psychrometers, anemometers and balances, instead of vascula and plant presses. Thus we shall again go afield, but on what a different quest! The old-time botanist in the field was mainly concerned with the question of the specific identity of each plant he found; the botanist afield in the future will ask what the plants are doing under this or that environment. He will not neglect the earlier question, in fact he must have that answered, but that answered he has still his main question before him. The work in the field laboratories must necessarily be of the kind now called ecological, and so as I see it the botany of the future will have much more of ecology than is common to-day.

Yet when we think of these botanical stations whose laboratories are taken afield, as it were, we must not suppose for a moment that the old-time laboratories on the uni-

versity campus are to be abandoned. Far from it. As the work in the field laboratories is enlarged there will be still greater need of the far more exact work that can be done only in laboratories where every factor can be perfectly controlled. There will still be need, greater need I might say, for perfectly constructed plant-houses in which we may observe plants under controlled conditions, and where we may increase or decrease this or that factor at will. I emphasize this point because there are some who prophesy the eventual abandonment of the precision laboratory in botany, when in fact everything points to the opposite conclusion.

Another kind of station, of which we have now only the beginnings, is one which will carry the results of plant breeding into the domain of phylogeny. Of this we have now some faint suggestions, which must grow into far reaching results under the direction of men who know more of the subject than we do now. It may be that such stations will then, as now, have a strong economic bias, but this will not so narrow them as to exclude the phylogenetic aspects of the work they are doing. In such laboratories we shall be able to see how evolution has contributed to the present wonderful diversity of form and size and color and habit among related plants. Such laboratories will enable us to answer the demand formerly so often made, but less often heard now, for a demonstration of cases of actual evolution. Although such cases are well known to botanists, their occurrence has hitherto not been such as to admit of easy citation for purposes of popular demonstration. So I regard the breeding laboratories of the future as welcome additions to the means of demonstration which science will possess.

Unity of Action.—Allow me to look once more into that future which holds so much of promise for botany. I am assured as I consider the trend of scientific thought that there will be greater unity of action among the botanists of the country. At present we are still in the guerrilla stage of botany, in which every man acts independently and for himself. And it must be admitted that much effective work is done by guerrillas in war and in science, but in both there is far too much waste of energy. Let me pause a moment to explain more fully what I mean by this guerrilla condition in botany. Although we profess to be botanists acting for the best interests of science, we have actually no uniform standard by which we may measure our actions. In one particular we have tried to set up a standard, in certain international rules pertaining to nomenclature: and yet after several congresses of botanists we have the humiliating spectacle of a set of laws that nearly everybody disobeys! In other matters also, every man does as he pleases; and the worst of it is that he vehemently defends this free, untrammeled mode of action. We have been guerrillas so long that we resent the suggestion of conformity to any regulation.

Brethren of the ancient order of botanists, this is scientifically quite unseemly. We must cease this personally independent, but disorderly life, and enroll ourselves in the regular army as good soldiers who will obey orders, and who will act in unison for the common good. And this is no illusory vision. It is one of the things that the future will bring us, yes, I may say, is bringing us. For already we find the beginnings of a reduction of some of the disorder in certain fields of work. In the management of the work of the agricultural experiment stations there are hopeful signs of a healthy progress. Certain officers in Washington, having general supervision over the stations, seeing that there is much useless

duplication, have begun suggesting more harmonious planning, one station to emphasize this line of investigation, and another that line, instead of working quite independently of one another. This beginning is suggestive of what might and should be done elsewhere.

And we shall not confine unification and coordination to investigation alone, but will carry it into the teaching departments. As a matter of course the more general aspects of the science must find place in every college department of botany, requiring to this extent the quite legitimate duplication of the best laboratory and other facilities that can be provided. But beyond this the duplication should cease, especially of facilities that are costly in installation and maintenance. When we fully reach a condition of scientific sanity we shall agree upon such a program as will assign particular fields of work to those institutions that are best able to care for them, and it follows that students will be sent to these for such specialties. In the case of the state institutions there is already the beginning of the attempt to reduce needless duplication—in some instances crudely and awkwardly, it is true—but the significant thing is that there is already an attempt to reduce duplication. Which suggests that "the children of this world are in their generation wiser than the children of light."

This is not the place for the discussion of the details of the educational cooperation which is coming—a cooperation which will result in a conservation of educational energy. As the details are needed they will be worked out, but I may be permitted to suggest that in the near future we shall reach a solution something like the following:

(*a*) That the small colleges shall provide a standard course in general botany, with adequate facilities as to material and apparatus.

(*b*) That the larger colleges and universities shall provide an identical standard course for those of its students who have not pursued this subject in the small colleges, and to this they will add certain advanced, also standardized, courses, requiring facilities beyond the reach of the small colleges.

(*c*) Then will come, especially in the state-supported schools, such advanced courses as are required by the nature of the institutions, and the needs of each particular state; as the study of useful plants, noxious plants, local systematic botany, dendrology, pathology, etc.

(*d*) Last will come a division of labor with regard to the more profound lines of research and teaching. Certain favored institutions will place especial emphasis upon minute anatomy (cytology and histology), or special morphology, or physiology, or plant breeding, or ecology, or phytogeography, or special taxonomy, or general and experimental evolution, or botanical history, etc.

These suggestions are not chimerical. They are indicated by the recent trend of scientific thought, which recognizes more and more the value of the conservation of human effort. And as I look into the future a vision rises before me of the scientific army, working harmoniously like well-drilled soldiers, and not wasting their strength by turning their guns on one another. In this army of science I see a company of thoroughly disciplined botanists who in orderly fashion plan their campaign. And, from the many doing severe garrison duty in the small colleges, to the heavy artillerymen in the big university fortifications, and the few isolated scouts along the frontier of special investigation, all are actuated by a common spirit of scientific patriotism and loyalty.

This, my botanical brothers, is what the

future is bringing us—a united, harmonious body of trained men, whose endeavor is to carry forward the banner of science, not for personal advantage, but for the glory of the science to which we have dedicated our lives.

CHARLES E. BESSEY

RECENT EXPLORATIONS IN SIBERIA

ACCORDING to recent information received from the American Consul at Vladivostok (transmitted to the Dept. of State, Sept. 10, 1912), and from other sources the following scientific exploration has been carried on during the current year in the Russian far east:

An important work was carried on in Siberia by the Russian Geological expeditions sent out to look for new gold deposits. The Russian Mining Department had expeditions in the Bargusin district on the Zeia River, in Minusinsk and in Kamchatka. The Russian Mineralogical Society was studying Lake Ingel in the Achinsk district. The Russian Geological Society has also begun an extensive study of the Kalbin Mountains in the Ust-Kamennogorsk district on the left bank of the river Irtish, where three independent parties are working at present. A Russian Gold Mining Company is studying the river Kolba, for which purpose three professors of the Tomsk University have been engaged. The Russian Geological Society has also sent out an expedition to study the country on the river Yenisei from Krasnoyarsk down to Dixon Island, situated in the Arctic Sea about two miles from the mouth of the Yenisei River. The purposes of this expedition are the study of the magnetism of the earth, and the definition of the astronomical coordinates for the northern sea route. An auxiliary motor schooner has been sent to the village Dudinskoe to serve as a temporary magnetic laboratory. The Yenisei River will also be studied from a botanical point of view, and the fish resources of the river are to be investigated.

The director of the Irkutsk Laboratory is making magnetic observations on the Lena River down to its ostuary, where the region of the maximum magnetic force is located. The Colonization Department is making studies of the flora and soil in the Semiretchie, Barabinskaia Steppes in Kainsk and Mariynsk districts and in Akmolinsk Province.

The Russian Society for the Study of Asia is investigating the unknown ruins on the right bank of the river Obi in the Barnaul district. Bones of animals and birds, stone and bone weapons and articles of bronze and copper have been found, as well as some fragments of pottery with ornaments belonging to an old civilization.

Dr. A. Hrdlička, of the United States National Museum, has been engaged in anthropological exploration along the upper Yenisei River, on the Selenga, and in northern Mongolia.

The Altai is attracting special interest and several well equipped expeditions are working there on various lines.

Siberia, and especially the Russian Far East, seem to attract a great deal of attention in Europe. The French Department of Education, the Geographical Society and the Museum of Natural and Historical Knowledge have sent Daniel Busson with assistants to Siberia to prepare ethnographical, anthropological and natural history collections, as well as to take photographs and moving pictures. From Irkutsk they are to go to the Transbaikal, and from there to Yakutsk by the Lena River and from the river Kolima to Vladivostok. Much interest is manifested in scientific circles, as well as by students of economics, in regard to this almost unexplored and unexploited country which is so rich in opportunity for the seeker after truth.

Professor George Mixter, of Boston, has recently concluded a successful scientific expedition and hunting trip in the vicinity of Lake Baikal under the auspices of the Smithsonian Institution, Washington.

A Russian expedition has been sent out from St. Petersburg to examine the coasts of the Okhotsk Sea, the valley of the Anadir River close to Behring Straits, and the Gischiti and Aldon valleys. The chief of the expedition is Mr. P. I. Polevoi, a learned geologist and mining engineer, who is accompanied by topographers of the army.

It is further reported that the following expeditions have or will also visit Siberia:

1. An expedition to the Altai Mountains by Professor Lyman and Mr. Hollister for the purpose of making a collection of plants and animals for the United States National Museum and Harvard University.

2. Dr. Stanislav Hanzlik, professor of Prague University, to make a study of climatical and meteorological conditions of the Russian Far East.

3. Sven Johan Ernandero, a Swedish explorer, to make a botanical study of western Siberia.

It should also be remarked that the matter of perfecting the northern route from Vladivostok to European ports via Behring Straits (so successfully navigated last year from Europe as far as the Yenisei River by the English navigator, Captain Webster, and from Vladivostok to Kolima River by a Russian vessel), and the charting of the new uncharted coast lines in many places on this route, is receiving attention from a special Russian expedition which sailed from Vladivostok at the opening of navigation this year. They will winter in the Arctic Sea and proceed next year on their voyage.

A. Hrdlička

THE REORGANIZATION OF THE MEDICAL DEPARTMENT OF THE UNIVERSITY OF CALIFORNIA

At a meeting of the regents of the University of California in December, 1911, the Committee on Medical Instruction recommended that the departments of the Medical School in Berkeley and San Francisco be brought together in San Francisco as soon as possible, that the clinical years be put upon an academic basis, and that a proper teaching hospital and proper laboratories be provided in order to promote the best interests of the university as a whole, and of the Medical School in particular. It was declared the desire of the board to establish a medical school of the highest standard.

At a meeting in April, 1912, upon the recommendation of the Medical Faculty, the following plan of reorganization was adopted. Clinical instruction in the medical school is to be carried on in three main departments. (1) Gynecology and obstetrics: it was decided to put this department upon an academic basis at once and to allot full academic salaries for a professor and an assistant. (2) Medicine: this department to include pediatrics, neurology and dermatology. This department can not as yet be placed upon a full academic basis, but $2,300 has been devoted to the payment of assistants for the current year. (3) Surgery: this department to include orthopedics, urology, ophthalmology, rhinology, otology and laryngology. As with medicine, there were not sufficient funds available this year to put the department upon a full academic basis, but $1,800 was devoted toward paying three assistants.

In addition to the main departments, the work of the hospital pathologist was reorganized and an additional assistant professor of pathology was secured at a salary of $2,400 a year. It was voted to grant $1,200 for the work in radiography.

The budget voted to medicine 1912–13, for maintenance of the first two years, was:

	Salaries	Budgets	Total
Anatomy	$11,500	$3,555	$15,055
Physiology and physiological chemistry	8,120	3,000	11,120
Pathology and bacteriology	9,900	3,800	13,700
Toward academic instruction in the clinical years			12,000
For additional expenses of the clinical years:			
General budget			7,630
Special budget for university hospital			6,480
Assistant superintendent and hospital stenographer			2,400
Deficit			12,000
Total for medical instruction			80,385

In accordance with the plans adopted by the regents, a movement is on foot to provide a new university hospital. The present plans aim at four units of forty to fifty beds each, to be devoted respectively to surgery, medicine, diseases of women and diseases of children. Money has already been given ($350,000) by private individuals to build and equip the departments of medicine and children's diseases. In order to carry on the work in the present buildings, the regents have granted $14,000 for alterations in the hospital for accommodation of clinics, and $6,000 for equipment of clinical and pathological laboratories. A children's ward has been added to the hospital.

SCIENTIFIC NOTES AND NEWS

The following have been elected corresponding members of the Munich Academy of Sciences: Dr. Otto Struve, professor of astron-

omy at Berlin; Dr. Mittag-Loeffler, professor of mathematics at Stockholm; Dr. H. A. Schwarz, professor of mathematics at Berlin; Dr. Walther Nernst, professor of physical chemistry at Berlin; Dr. Sigismond Exner, professor of physiology at Vienna; Professor A. G. Nathorst, director of the Paleontological Museum at Stockholm, and Mr. Bailey Willis, of the U. S. Geological Survey.

DR. H. A. LORENTZ, professor of physics at Leiden, has been made an honorary member, and Dr. Ernest Rutherford, professor of physics at Manchester, and Dr. W. C. Brögger, professor of geology at Christiania, have been made corresponding members, of the Vienna Academy of Sciences.

THE honorary degree of D.C.L. has been conferred on Sir William Osler, regius professor of medicine at Oxford by Durham University.

THE Paris Academy of Sciences has awarded its Binoux prize (for the history of science) to Professor J. L. Heiberg, of the University of Copenhagen, for his works on the history of ancient mathematics and in particular for those on the method of Archimedes.

DIRECTOR BAILEY has been appointed to represent Cornell University at the inauguration of Dr. C. A. Duniway as president of the University of Wyoming on January 24. Besides making a speech at the inauguration, Mr. Bailey will make an address on the occasion of the laying of the corner stone of Wyoming's new agricultural building.

ON the evening of December 17, the Linnean Society of New York held its first annual banquet at which Mr. Frank M. Chapman was the guest of honor. The occasion had the twofold object of inaugurating a series of annual dinners and of honoring Mr. Chapman for his distinguished services to ornithology. Dr. Jonathan Dwight, Jr., president of the society, acted as toastmaster, and among other guests at the speaker's table besides Mr. Chapman were Dr. Henry Fairfield Osborn, Mr. John Burroughs, Dr. A. K. Fisher, Mr. George Bird Grinnell, Mr. T. Gilbert Pearson, Dr. Frederic A. Lucas, Mr. Spencer Trotter, Mr. Ernest T. Seaton and Mr. John H. Sage.

PROFESSOR H. J. WHEELER, for the past ten years director of the Agricultural Experiment Station of the Rhode Island State College, who recently resigned, has accepted the position as manager of the Agricultural Service Bureau of the American Agricultural Chemical Company of Boston and New York, with headquarters at 92 State St., Boston, Mass.

MR. BENJAMIN BOSS has been appointed acting editor of the *Astronomical Journal.*

MR. H. D. GOODALE has recently been appointed by the trustees of the Massachusetts Agricultural College as research biologist in the department of poultry husbandry of the experiment station. Mr. Goodale graduated from Trinity College in 1903; after spending a year in graduate work at that institution, he spent three years at Columbia University as a special student of zoology. From 1907 to 1911 he was engaged in farming, and since 1911 has been employed by the Carnegie Institution of Washington in its department of experimental evolution.

THE cornerstone of the new dispensary building of the College of Medicine of Syracuse University was laid on December 14 by Chancellor Day. Afterwards addresses were made by Dr. William S. Thayer, of the Johns Hopkins University; Mr. Augustus S. Downing, assistant commissioner of education of the state of New York, and Mr. Alan C. Forbes, who spoke on behalf of the Syracuse Free Dispensary Association.

PROFESSOR MARSTON TAYLOR BOGERT, of the department of chemistry, Columbia University, president of the Society of Chemical Industry, lectured on December 16, before the McGill Chemical Society, Montreal, on the subject of "The Classification of Carbon Compounds," and in the evening addressed the Montreal members of the Society of Chemical Industry at a banquet at Coopers Limited. On the following day he addressed the Toronto members of the society at a banquet at the Engineers' Club, Toronto, on the subject of "A Closer Cooperation between the Universities and Chemical Industries."

Dr. E. V. Farwell, associate professor in the department of chemistry of the college of agriculture of the University of Wisconsin, lectured to the students of the department of chemistry, on December 18, on "The Rôle of Mineral Elements in Nutrition."

Dr. E. P. Lyon, of St. Louis University School of Medicine, recently delivered the Founders Day address at the Bradley Polytechnic Institute, Peoria, Ill., on the subject, "Medicine and Engineering."

Mr. Austen Chamberlain will preside at a meeting at the Royal Colonial Institute, London, on January 14, in support of the fund he is raising for the extension and development of the London School of Tropical Medicine, when Sir Ronald Ross will give an address on the work of the school and the advantages of tropical medicine.

Certain geological works of Dr. Alexander Winchell, former professor of geology at the University of Michigan, have recently been found at the state capitol at Lansing, where they have been kept since Dr. Winchell's death forty years ago. Over four hundred works are included in the collection, which is a very valuable one, including plates and hand drawings. The works are the property of the Michigan State Geological and Biological Survey, and will be published in an appropriate form.

The valuable collection of microscopic slides and preparations left by the late Professor T. H. Montgomery, Jr., have been given by Mrs. Montgomery to the zoological department of the University of Pennsylvania. The collection comprises upward of 3,800 mounted pieces and slides, in addition to a large number of objects embedded in paraffin.

Mr. William B. Tegetmeier, the distinguished English naturalist, known for his work on pigeons and other animals and for his cooperation with Charles Darwin in the study of variation, has died in his ninety-seventh year.

Mr. Chester A. Reed, curator of the Worcester Natural History Society and the author of several books on bird life, died at Worcester on December 16.

Mr. Eugene Smith, a Brooklyn engineer, interested in natural science and editor of *The Aquarium*, died on December 25, aged fifty-two years.

Dr. Ernst von Koken, professor of geology at Tübingen, has died at the age of fifty-two years.

Dr. Wilhelm Fiedler, formerly professor of mathematics in the Zurich Technical School, has died at the age of eighty years.

M. Aimé Pagnoul, formerly director of the Agricultural Station at Pas-de-Calais, has died at the age of ninety years.

The examination for the position of curator of the State Natural History Museum of Illinois, recently mentioned in these columns, has been postponed by the civil service commission until January 25, in order to secure more applicants. This is a position which pays $3,000 per year. Applications should be on file in the office of the state Civil Service Commission, Springfield, Ill., not later than January 18.

The next meeting of the International Union for Solar Research will take place at Bonn beginning August 1, 1913.

An international congress for physical education will be held in Paris, March 17–20, 1913, under the auspices of the faculty of medicine. It is expected that the United States will be represented.

In view of the seventeenth International Congress of Medicine, which is to take place in London in 1913, a committee has been formed for the purpose of organizing a museum, and Professor Arthur Keith, conservator of the Royal College of Surgeons' Museum, has been chosen chairman. Accommodation has been secured at the Imperial College of Science, South Kensington, and the museum will be arranged in this place as far as is possible in correspondence with the sections of the congress. It has been decided that, as the meeting is to take place in London, and as the visitors will doubtless desire to inspect the metropolitan hospitals and other great institutions, material will not be collected from the museums of the metropolis. The committee

are therefore seeking exhibits from provincial institutions and from private collections.

IT is stated in the British *Geographical Magazine* that the Paris Society of Natural Sciences has succeeded in making all arrangements for the establishment of a magnificent national park, of which an account was given by Dr. Paul Sarasin at the September meeting of the society at Altdorf. The park is situated in the canton Grisons, in the lower valley of the Inn, near Zernetz, and consists meantime of an uninterrupted stretch of land about forty square miles in extent, which it is hoped later to increase to nearly eighty square miles. All this vast territory will be wholly withdrawn from human interference, and set aside as a biological preserve. It contains at present chamois, a few bears, and a rich flora. Some paths are to be made, together with blockhouses to suppress poaching, and regular observations will be undertaken. Part of the territory has been leased for twenty-five years, and the rest for ninety-nine years, and the cost of rent, surveillance, and observations are to be defrayed out of the funds supplied by a popular league, with a very low annual subscription.

IT will be remembered that at the Dundee meeting of the British Association in September last the president of the Zoological Section, Dr. P. Chalmers Mitchell, F.R.S., took as the subject of his address "The Preservation of Fauna." At the close of the meeting the general committee passed on to the council, for consideration, a resolution, which has now been adopted in the following terms:

That the British Association for the Advancement of Science deplores the rapid destruction of fauna and flora throughout the world, and regards it as an urgent duty that steps should be taken, by the formation of suitably placed reserves, or otherwise, to secure the preservation of examples of all species of animals and plants, irrespective of their economic or sporting value, except in cases where it has been clearly proved that the preservation of particular organisms, even in restricted numbers and places, is a menace to human welfare.

THE thirtieth expedition of the Liverpool School of Tropical Medicine, under Dr. Harald Seidelin, of the Yellow Fever Bureau of the school, sailed from Southampton for Jamaica on December 17. The main object of the expedition is to investigate the disease called "vomiting sickness," which is often fatal to children. The expedition has been promised the support of the English government and of the government of Jamaica.

THE Ohio Academy of Science held a successful meeting at the Ohio State University from November 28 to 30, 1912. The program contained about fifty papers on various subjects in the fields of zoology, botany, geology and physics. The physicists organized a new section in the academy during the past year and participated in the program of this annual meeting for the first time. Eleven papers on various subjects in physics were presented. Mr. Emerson McMillin, of New York, renewed his annual donation of $250 for research work to be conducted under the auspices of the academy. This gift has been continued for a number of years and has been the means of assisting a large number of important scientific investigations. The Biological Survey of Ohio, which was organized during the past year through the cooperation of the Ohio State University and fourteen other colleges of the state, was heartily commended by resolution and the earnest support of the academy was pledged to the undertaking. Another resolution of importance adopted by the academy was one calling for legislation by the state to prevent the propagation of the feeble-minded, insane and habitual criminal. Professor L. B. Walton, of Kenyon College, Gambier, and Professor E. L. Rice, of Ohio Wesleyan University, Delaware, were elected president and secretary, respectively, for the coming year.

THE University of Minnesota is offering a series of lectures upon "Modern Developments in Science." These lectures are given by members of the regular staff of instruction, on Wednesday evenings, in the chemistry building. The program of the series follows:

November 13—"Practical Applications of the Gyroscope," Assistant Professor B. L. Newkirk.

November 20—"Comets I have Known," Professor F. P. Leavenworth.

November 27—"Thunder and Lightning," Professor John Zeleny.

December 4—"Radium, its use in Physics and Medicine," Assistant Professor Alois F. Kovarik.

December 11—"Electrical Transmission of Intelligence," Professor G. D. Shepardson.

December 18—"Some Advances in Modern Bridge Engineering," Professor Frank H. Constant.

January 15—"The Air We Breathe," Dean George B. Frankforter.

January 22—"A Geological Exploration in Southwest Colorado," Professor W. H. Emmons.

January 29—"American Metal Mining," Professor Chas. E. van Barneveld.

February 5—"Geographical Studies in Glacier National Park," Assistant Professor E. M. Lehnerts.

February 19—"The Influence of the Study of Fossils—Paleontology," Assistant Professor F. W. Sardeson.

February 26—"Heredity and Eugenics," Professor H. F. Nachtrieb.

March 5—"Plants and the Cost of Living," Professor F. E. Clements.

March 12—"Sickness in Plants—Causes and Remedies," Professor E. M. Freeman.

March 19—"Modern Warfare against Grasshoppers; and Protective Coloration and Mimicry of Insects," Professor F. L. Washburn.

April 2—"Some Recent Developments in the Study of the Nervous System," Professor J. B. Johnston.

April 9—"The Special Child," Professor J. B. Miner.

April 16—"Recent Progress in the Study and Cure of Cancer," Dr. H. E. Robertson.

April 23—"Modern Surgery," Dr. A. T. Mann.

April 30—"The Two Most Important Epochs in the History of Modern Medicine: the Discovery of Vaccination and the Discovery of the Relation of Microorganisms to Disease and the Application of the Antiseptic Principle to the Practise of Surgery," Dr. Burnside Foster.

May 7—"Living with Head Hunters," Professor Albert E. Jenks.

We learn from the *Geographical Journal* that the attention directed of late years to the antiquarian remains at Tiahuanacu has led the Bolivian Minister of Public Instruction, at the instance of Señor Ballivián, to provide funds for the systematic excavation of the site of the ruins, with a view to saving them from further depredations of a kind to which they have been subject in the past. The work has been carried out under the supervision of the director of the National Museum, Dr. Otto Buchtien, and a report on the results so far gained has been circulated by Señor Ballivián. At a depth of from 3 to 10 feet below the surface a large quantity of pottery was found, of pre-Inca age, many of the objects being in a perfect state of preservation. They at once rivet the attention by the fineness of the material, and in the case of the cups, bowls, etc., by their artistic form as well as by the excellence and freshness of the coloring. The diversity of the ideographs and pictographs represented on them will demand special study by experts. Among the smaller objects, a human figure in silver is interesting as showing the nature of the garments worn in that ancient time. Worked stones have also been found, and skulls showing distinct traces of deformation. One of the latest discoveries had been a skull, belonging apparently to an ancient race, and showing the frontal suture and larger in all its dimensions than skulls of the present day. Further reports are promised as the work progresses.

UNIVERSITY AND EDUCATIONAL NEWS

The Hamburg senate has adopted the proposal to found a university there consisting of three faculties—law, philosophy and colonial science. These are to be supported by the interest on $6,250,000, which has been appropriated for the purpose by the city.

The program for the exercises at the dedication of Lincoln Hall, University of Illinois, to be held on February 12, includes addresses by Mr. Hugh Black, Governor Deneen and Bishop McDowell of Chicago. Lincoln Hall was made possible by an appropriation of $250,000 by the legislature in 1909, the one hundredth anniversary of Lincoln's birth and it was decided to give the building its present name and dedicate it to the study of humanities.

DR. BURT L. HARTWELL, professor of agricultural chemistry in the Rhode Island State College, has been appointed director of the station to succeed Dr. Homer H. Wheeler, who recently resigned.

MR. E. G. ARZBERGER, H. R. Watts, J. B. Demaree, L. E. Melchers and J. T. Rogers, assistant botanists in the botanical department of the Ohio Agricultural Experiment Station, have resigned from their positions.

DR. J. W. NICHOLSON, M.A., Trinity College, Cambridge, has been appointed professor of mathematics in London University, being attached to King's College.

DR. W. H. PERKIN, F.R.S., professor of chemistry at Manchester University, has been elected Waynflete professor of chemistry at Oxford. A grant of £15,000 towards the erection of the new chemical laboratory, as well as a further loan, has been promised by the trustees of the chancellor's endowment fund.

DISCUSSION AND CORRESPONDENCE

A NEW WEED EXTERMINATOR

WILD garlic (*Allium vineale*) has become a serious farm pest, especially in the belt of territory extending from Maryland to Missouri. Beside having the usual competitive action as a weed in cultivated fields, the presence of bulblets in wheat lowers the market value, as the bulblets are about the size and color of the grains, and difficult to separate. The weed also gives an unpleasant taint to the milk and flesh of animals feeding on the leaves, and to flour made from wheat containing the bulblets.

Owing to the remarkable tenacity of life possessed by the bulbs and bulblets no practical method to rid the soil of the pest has heretofore been found, and in some localities fields have been abandoned and given over to the weed.

Nearly two years ago an investigation of the wild garlic was taken up as a special problem by the Botanical Department of the Indiana Experiment Station. The field tests were carried on in cooperation with Dr. H. E. Horton, agronomist of the American Steel & Wire Co., and Mr. Jacob Cronbach, of Mount Vernon, Ind. After various chemical sprays and cultural methods had been tried to little purpose, Mr. F. J. Pipal, assistant botanist in the Indiana Station and in direct charge of the work, suggested the use of orchard heating oil, as supplied by the Standard Oil Co., applied as a spray.

Remarkable results were obtained from the beginning of the tests. It was found that when the oil was distributed over the field in a fine spray by a sufficiently powerful spraying machine, that all growing vegetation was killed, not only above ground but below ground as well, except the long horizontal rootstocks of such plants as *Tecoma radicans* and *Solanum carolinense,* and the extra large roots of such plants as *Ipomœa pandurata,* the latter requiring a correspondingly larger amount of oil. It destroyed the bulbs of the wild garlic, however deep below the surface, and the bulblets at the tops of the stalks as well. The oil appeared to produce no lasting effects upon the soil, and new growth from seeds already in the soil and from subsequently sowed cereals possessed the usual vigor. The best times and methods for the application are now being tested.

The introduction of this new material for killing weeds is accompanied by a new method of application. Heretofore chemical sprays have been differential, and intended to kill only the weeds while leaving the crops essentially unharmed. Orchard heating oil acts as a complete spray, killing all vegetation, like plowing or fire, only more effectively than these, as it follows the stems and roots well into the ground.

J. C. ARTHUR
INDIANA EXPERIMENT STATION,
PURDUE UNIVERSITY

GREEK REFINEMENTS IN ARCHITECTURE

THE existence of subtleties of line and spacing in Greek architecture is now well known. A very interesting point is how much of the classic practise was lost in the Dark Ages and how much preserved. The following extract from "Evelyn's Diary" seems to bear upon the point. It shows, at least, that

similar problems were familiar to English architects of the seventeenth century.

1666, Aug. 27, I went to St. Paule's church, where with Dr. Wren, Mr. Prat, Mr. May, Mr. Thos. Chichley, Mr. Slingsby, the Bishop of London, the Deane of St. Paule's and several expert workmen, we went about to survey the general decays of that ancient and venerable church, and to set downe in writing the particulars of what was fit to be don, with the charge thereof, giving our opinion from article to article. Finding the maine building to recede outwards, it was the opinion of Mr. Chichley and Mr. Prat that it had been so built *ab origine* for an effect in perspective, in regard of the height; but I was, with Dr. Wren, quite of another judgment, and so we entered it; we plumb'd the uprights in severall places. . . . (From Evelyn's Diary.)

Edward S. Holden

West Point, N. Y.,
November, 1912

THE QUESTION OF THE OLDER AND NEWER APPALACHIANS

In a lucid and valuable article on the geography of the United States, Professor Wm. M. Davis divides the Appalachians[1] into an older eastern and a newer western belt. He makes in New England the Taconics and the great limestone valley the newer, and all the rest of New England from and including the Green Mountain range the older. By this he means composed mainly of older rocks.

The distinction is good, but the names should be reversed for New England.

The western division contains mainly Cambrian and Ordovician rocks. A narrow interrupted band of Archæan forms the west border of the eastern band, going south from the Hoosac Tunnel. Next east is a band of the Hoosac and Rowe schists, which are correlated with the Berkshire schist of the western division and so are Ordovician. Next east is the much broader band of the "Calciferous Mica Schist" (the Goshen and Conway schists), which extends to the Connecticut Valley, and widens northerly into Canada, carrying Silurian fossils. Next east is the Bernardston Devonian, underlying the Connecticut Valley and in part covered by Trias. The whole of Worcester County is Carboniferous, cut by late Carboniferous granites. The new discovery of Carboniferous fossils in Worcester by David White reinforces Perry's earlier finds, and all the Carboniferous rock types occur in the eastern rim of the Connecticut Valley, and all the intervening country can be connected by transitions with the undoubted Carboniferous.

East of Worcester is a narrow seaward band of Algonkian and Cambrian greatly covered by Carboniferous, so that about nine tenths of the area between the Housatonic Valley and the sea is covered by rocks newer than those of this valley and the Taconics.

This change of name does not lessen the great value of the distinction, which is based not so much on age as on the presence of the great limestone in the western belt and its lesser metamorphism, which has caused great differences in the topography. The lesser metamorphism of the western belt depends, in part, on the absence of granite which has overwhelmed all the area of the eastern belt. They have both been subjected to the same folding and uplifting agencies, but the overthrust faulting along the east border of the limestone valley has had for an effect that less and more varied pressure was transmitted westwardly, while the greater pressure in the east has not only caused greater metamorphism across central New England, but the extensive intrusion of various granites has greatly increased this metamorphism, and has left a country where a very broad meshed network of Carboniferous schists rests in great areas of carboniferous granite.

The eastern division, which has for its western border the Green and Hoosic Mountains, constitutes the New England Province, and, taken as a whole, has an interesting balanced arrangement. The ancient Green Mountain protaxis made up of Archæan to Ordovician rocks is balanced on the east by the equally ancient Nova Scotian series, which is lithologically similar, and both are gold bearing.

Next inwardly the narrow fault bounded

[1] Mill's "International Geography," pp. 717–732.

Connecticut Valley depression with its Triassic traps and sandstones stands over against the similar narrow Triassic basin of the Bay of Fundy, continued in the Boston and Narragansett basins. There remains the broad central New England Plateau, made up of great late-Carboniferous granite batholites running north and south, or with a little easting and isolated by bands, often very narrow, of late Paleozoic rocks, largely Carboniferous.

The series of batholites in this central plateau is itself symmetrically arranged and becomes more basic from the center outwardly.

Crossing the center of the plateau from north to south is the broad Hubbardston-Princeton band of granite which is truncated by erosion so nearly along its contact with the cover of Carboniferous schists, that it is everywhere contaminated with the sillimanite and graphite of these schists, and is made coarsely pegmatitic from the water obtained from them.

Next on the east is the long train of oval batholites running through Worcester, the Ayre series, which are of uniform porphyritic texture, and are matched on the west by the coarsely porphyritic Coy's Hill series, passing east of Ware.

Next outwardly the dark biotite Bolton granite-gneiss on the east is matched by the broad band of the black Hardwick biotite granite, passing through Ware.

Then follows on the east the fine-grained Milford biotite granite, so valuable as a building stone, which is comparable with the Monson and Pelham biotite granites on the west, which are also extensively quarried.

Finally, the complex Quincey-Dedham series of igneous rocks along the eastern border of the area, with its basic and soda-rich rocks, is balanced by the basic Belchertown series, which is a counterpart of the Cortlandt series, and borders the plateau on the west. Each marks the locus of a principal fault system which form, respectively, the eastern and western limit of the plateau. By contrast faulting is wanting or inconspicuous in all the central portion of the province.

B. K. EMERSON

AMHERST COLLEGE

SCIENTIFIC BOOKS

Oxidations and Reductions in the Animal Body. By H. D. DAKIN, D.Sc., F.I.C., The Herter Laboratory, New York. Longmans, Green & Co., New York. 1912. Pp. viii + 135. Price $1.40 net.

For some time in the past, "energy" has been the keyword of the theories of nutrition. The problems presented in relation to the transformation of energy in the body were so conspicuous and the technique of investigation so effectively improved in application to the study of the metabolism of energy, that other aspects of the subject were neglected. This trend of the science is reflected in the popular literature of the present time when expressions like "calories" and "fuel value" are employed with the skill of the conjurer to impress the uninitiated. The mere comparison of the intake and the output of the organism and the broad statement that metabolism is essentially a process of oxidation change has, however, long since failed to satisfy the more critical inquirer; and accordingly the questions of what is now termed intermediary metabolism, concerned with the destiny of the individual nutrients or corresponding tissue components, are forging to the front. The newer knowledge of the chemistry of the digestive processes has made great strides in a decade or two. Yet how little we know of the various steps beyond the barrier of the intestinal wall.

It is of certain of these intricate processes considered primarily as chemical reactions that the present monograph aims to give an account. The animus of the attempt at what is essentially a novelty in the literature of physiology may be elicited from a few quotations. Dakin writes:

> The statements that fats and sugars are oxidized in the body to carbon dioxide and water, while proteins yield urea in addition, are no longer considered all-sufficient explanations of the chemical rôle of these substances in the animal economy. The study of chemical structure is rapidly changing the whole aspect of biological science, and we may confidently look forward to the time when the orderly succession of chemical reactions consti-

tuting the activities of the living cell will be resolved into their individual phases. . . . It is relatively easy to obtain a balance sheet representing the intake and output of substances in the animal body, but what is fundamentally necessary for the proper appreciation of this balance sheet is a knowledge of the various chemical transactions which (to continue the simile) should be comprised in a trading account. For it is by the proper adjustment and regulation of these transactions that the energy represented by food and tissue substance are economically utilized according to the varying needs of the body. The rapidly developing appreciation of the fact that different proteins, fats and sugars are not physiologically equivalent but that certain definite chemical groups subserve special functions in the animal organism emphasizes the necessity of the study of intermediary metabolism. . . . A true knowledge of metabolic processes can only be obtained by the tedious unravelling of the complex system of biochemical changes into individual chemical reactions. At the present time only a few of these simple reactions have been recognized and studied, but even now it requires little imagination to realize that in the future it will be possible to construct an accurately itemized account of the animal body's chemical transactions, both anabolic and catabolic. The value of such knowledge for the advancement of biology and medicine is sufficiently obvious.

Dakin's book emphasizes the fact that many of the striking biochemical reactions can already be imitated to-day more or less successfully by experiments in vitro. This is, of course, a helpful assurance, serving to divert attention from vague speculation regarding subtle vital forces. It has been a popular practise to appeal to hypothetical enzymes to explain some of the obscure chemical transformations in the organism. Thus we have been wandering through the mazes of the oxidases, oxygenases, peroxidases, reductases, catalases and other products of perplexing nomenclature in the hope of escaping the uncertainties of intermediary metabolism. Much of the obscurity is at length dispelled by a vigorous presentation in which questions of chemical structure are paramount and details of biological processes are exemplified in actual experiment or by clear analogy.

In connection with the oxidative capacity of the body Dakin points out the accumulating evidence in favor of the hypothesis of superoxide formation in living cells. With regard to the possibility of biochemical reductions reference is made to the interesting Cannizzaro reaction whereby the reduction of one molecule of substance takes place with the simultaneous oxidation of a second molecule, according to the scheme:

$$2\,R \cdot CHO + H_2O = R \cdot CH_2OH + R \cdot COOH.$$

A brief chapter on the methods of investigation formulates the attitude of mind with which the student of intermediary metabolism approaches his problems. It is a decidedly exceptional outline of the viewpoints which may guide the worker in this field in the direction of successful experimentation.

Pointing out that it is only since the publication of Knoop's important studies in 1904 that any material progress has been made in the experimental investigation of fatty acid katabolism, Dakin subjects Knoop's theory of β-oxidation to a critical analysis. He shows that chemical analogies for this are found in the behavior of fatty acids towards hydrogen peroxide, so that by the choice of a suitable oxidizing agent the occurrence of β-oxidation can readily be demonstrated *in vitro*. Physiological experiments continue to furnish striking confirmation of the theory. The relative importance of the β-hydroxy- and β-ketonic acids in the mechanism of the reaction are discussed with abundant reference to the growing illustrative literature to which the author of the monograph has furnished prominent experimental contributions. Other types of reaction than that of β-oxidation have not yet been observed, and it is not likely that α-oxidation of normal saturated fatty acids takes place in the animal body.

In turn the behavior of the unsaturated acids, the oxidation of acids with branched chains, the dibasic acids, aromatic compounds, amino-, hydroxy- and ketonic acids are reviewed. The intimate biochemical relation

of the latter groups, illustrated by the scheme,

$$CH_3 \cdot CHNH_2 \cdot COOH \rightleftarrows CH_3 \cdot CO \cdot COOH \rightleftarrows CH_3 \cdot CHOH \cdot COOH,$$

furnishes a text for the discussion of some of the manifold metabolic performances that have only lately found a place in physiological speculations. The oxidation and reduction of amino-acids by microorganisms, with reference to the splendid newer work of F. Ehrlich and of Neuberg in this field, is presented in novel, though brief form. In his treatment of the behavior of the carbohydrates Dakin champions the view that lactic acid must be regarded as one of the most important substances concerned with their intermediate metabolism. There are further chapters on the purines, hydrocarbons, phenols, etc.; and in conformity with the plan of the series of monographs on biochemistry to which this book belongs there is a well-arranged bibliography appended.

The frankness with which open questions are presented, as illustrated in the debated respective rôles of β-ketonic and β-hydroxy acids, is wholesome and marks the unbiased attitude of the book's author, even where his own researches are involved. The reader is impressed with the great advances which have lately been made in the new field covered by this monograph; and whether his interests are primarily those of the physiologist or the chemist, he will be stimulated by the wealth of suggestions—all presented there in a readable form.

LAFAYETTE B. MENDEL
SHEFFIELD SCIENTIFIC SCHOOL,
YALE UNIVERSITY

The North American Dragon Flies of the Genus Æshna. By E. M. WALKER. University of Toronto Studies. 1912.

It occasionally happens that some familiar group of animals is investigated by one who is sufficiently skilled and independent to detect characters which have escaped all previous observers. I recall the time, now a quarter of a century ago, when certain common land molluscs were added to the British list. One of these was almost literally in every one's garden, but until its distinctive characters were pointed out, nobody could see it. To-day the merest beginner can recognize it at once. We are forced to conclude that even excellent manuals are not without their disadvantages, when they are blindly followed by naturalists, who will not even look for things unmentioned by them. The same sort of thing has been very evident in botany, and we have in Mr. Walker's work a remarkable exposure of blindness in the field of entomology. Mr. Walker, during the summer of 1906, was at Lake Simcoe, Ontario, where he interested himself in the common large dragon flies of the genus *Æshna.* Most people would have viewed them with languid interest as being among the "familiar objects of the country side," completely exploited by entomologists long ago. Not so Mr. Walker, who with critical eye presently discerned that there were more species than the books called for. His curiosity thus stimulated, he pursued the subject further, and was eventually able to establish the existence of sixteen perfectly valid species in temperate North America, five of them described as new by himself. While doing this he has monographed the genus as represented in this country, and now publishes a most exhaustive treatment, discussing the biology, early stages, geographical distribution and other matters. The work is also fully illustrated, with 28 plates and some good text figures. Only one thing seems lacking: I find no mention of Scudder's *Æshna solida,* which is represented by such beautifully preserved wings in the Miocene shales at Florissant.

The interesting fact is brought out that in addition to "structural" characters, each species has its own color-pattern, which may at once be recognized when known. It is also found that the immature forms, the nymphs, have characters of their own, which are duly set forth in a key. It is thought probable or possible that the genus *Æshna* is of polyphyletic origin, the *californica* group especially having perhaps a different origin from the

rest. In *Entomological News*, 1908, p. 458, I gave reasons for thinking that *A. californica* deserved subgeneric rank; Mr. Walker's results appear to support this idea, and even suggest the question whether it should not be generically separated, taking with it several related forms.

Certainly Mr. Walker's book should be in every biological laboratory, both as an example of good taxonomy and as a useful work of reference, *Æshna* being common nearly everywhere.

T. D. A. Cockerell
University of Colorado

SPECIAL ARTICLES

A PRELIMINARY NOTE ON THE COAGULATION OF PROTEINS BY ULTRAVIOLET LIGHT

In order to gain some insight into the action of ultraviolet light on living cells it became necessary to study its effect on certain constituents of protoplasm. Attention was first given to proteins and a series of experiments were made with egg-white, egg albumin and ox-serum.

1. *Experiments with Egg-white.*—Fresh egg-white was cut up with scissors and placed in a quartz tube, at room temperature, 10 cm. from a quartz mercury-vapor lamp. The tube was completely filled and stoppered. After 1 or 2 hours a feathery coagulum began to form in the tube upon the wall nearest the lamp. This coagulum increased in amount, and after 35 hours the tube was quite full of a flocculent coagulum. There was a peculiar strong odor.

Fresh egg-white was diluted with an equal amount of distilled water. The solution became opalescent from the precipitated globulin. The tube was exposed at room temperature in the same manner as the tube containing the undiluted egg-white. There was a similar coagulation, but it was more abundant. There was also the same peculiar odor. In this case the coagulum slowly settled as it formed. The solution, therefore, was clearer, and there may have been a better penetration of the light. In another experiment the precipitated globulin was filtered out before exposure. Fifteen hours after filtering, the solution was still clear. On exposure to the light a fine sediment was formed which slowly settled to the bottom of the tube. The characteristic odor was present.

In all the experiments described above control preparations in glass tubes, exposed in the same manner, and at the same temperature, gave little or no coagulum, and none of the characteristic odor. The coagulum formed in the quartz tubes, whether they were open or closed. It formed equally well in tubes which had been connected with the air-pump and pumped out so as to remove the dissolved air. No bubbles of gas were formed during the exposure, nor could gases be detected in the solution by pumping with the air pump after the exposure.

2. *Experiments with Crystallized Egg-albumin.*—Crystallized egg-albumin was prepared by the method described by Hopkins and Pinkus. The egg albumin was recrystallized seven times. The ammonium sulfate which came down in the last crystallization was not dialyzed out. Solutions were prepared containing 1, 2, 5, 10 and 20-per-cent. of the albumin. All were exposed in quartz tubes at room temperature. The 5-per-cent. solution gave the most coagulum and in subsequent experiments with crystallized albumin 5 per cent. solutions were used. Coagulation was much more rapid in the crystallized albumin plus the ammonium sulfate, than in the fresh egg-white.

3. *Experiments with Crystallized Egg-albumin Dialyzed Against Tap Water.*—Albumin freed from ammonium sulfate by dialyzing against tap water coagulates very readily when exposed to the light at room temperature. It may be sensitive to longer wavelengths than the fresh egg-white, since considerable coagulum forms in the glass tubes. A quartz and a glass tube were exposed at room temperature for 15 hours. The quartz tube became opalescent and then opaque with a finely divided coagulum which did not settle, but which could be thrown down with a centrifuge. A feathery coagulum formed in the glass tube on the side nearest the lamp. This increased in amount, until the tube was filled

with a feathery coagulum. When the tube was moved, the coagulum separated from wall of the tube and settled to the bottom, leaving the solution in the tube perfectly clear. Further exposure of 20 hours produced only one or two scarcely visible masses of coagulum in the clear solution above the coagulum at the bottom of the tube. The solution contained, however, an abundance of albumin which could be coagulated by heat.

4. *Experiments with Ox-serum.*—The serum was prepared by allowing a clot to form and then decanting off the clear liquid. A portion of this was placed in a quartz test tube and exposed to the light at room temperature. As in the other cases a coagulum formed in the quartz tube while none formed in the glass tube which was exposed at the same time.

The coagulum produced by the light in egg-white and egg-albumin is insoluble in alcohol, hot or cold water and dilute acids. It is soluble in dilute alkalies. In these respects it agrees with the ordinary coagulum which is produced by heat without exposure to ultra-violet light.

W. T. BOVIE
LABORATORY OF PLANT PHYSIOLOGY,
HARVARD UNIVERSITY

ASTRONOMICAL AND ASTROPHYSICAL SOCIETY OF AMERICA

THE fourteenth meeting of this society was held at the Allegheny Observatory and the Schenley Hotel, Pittsburgh, from Tuesday to Friday, August 27–31, 1912. Sessions were held at the Observatory on Tuesday and Wednesday, the afternoon of Wednesday being occupied by the exercises of dedication of the new observatory. On Thursday and Friday sessions were held at the Schenley Hotel. An excursion to the Homestead Steel Plant of the Carnegie Steel Company, and a visit to the Carnegie Institute added much to the pleasure of the meeting.

The following members were in attendance: A. T. G. Apple, R. H. Baker, L. A. Bauer, B. Boss, J. A. Brashear, Miss Annie J. Cannon, G. C. Comstock, Z. Daniel, H. S. Davis, A. E. Douglass, W. S. Eichelberger, Philip Fox, Edgar Frisby, Miss Caroline Furness, William Gaertner, Miss A. M. Harwood, F. C. Jordan, T. A. Lawes, F. B. Littell, R. J. McDiarmid, J. B. McDowell, D. B. Marsh, J. A. Miller, O. L. Petitdidier, E. C. Pickering, J. S. Plaskett, A. W. Quimby, H. Raymond, E. D. Roe, Jr., H. B. Rumrill, F. Schlesinger, W. L. Scaife, H. Shapley, A. N. Skinner, F. Slocum, Elliott Smith, C. E. St. John, DeLisle Stewart, R. M. Stewart, Miss Helen M. Swartz, S. D. Thaw, Miss Stella May Udick, C. E. VanOrstrand, Miss Sarah F. Whiting.

Visiting astronomers: Louise S. Smith, A. van Maanen.

The following new members were elected: Miss Stella May Udick, Messrs. Harry Raymond, James Hartness, Arthur Newton, Henry G. Gale, David Rines, E. S. Haynes, William L. Scaife, James B. McDowell.

The constitution of the society was amended to provide for the election of honorary members. In accordance with the provisions of the amendment, nominations were received. Sir David Gill was unanimously elected the first honorary member of the society.

The council voted to hold no meeting in the summer of 1913, because of the probable absence of a number of the members in attendance at the Solar Union meeting at Bonn. The next meeting will be in Cleveland during the holidays, 1912, in connection with the American Association for the Advancement of Science. The council voted to hold the 1914 summer meeting at Northwestern University and the 1915 meeting in San Francisco and at the Lick Observatory.

Officers were elected:

President—E. C. Pickering.
First Vice-president—G. C. Comstock.
Second Vice-president—Frank Schlesinger.
Secretary—Philip Fox.
Treasurer—Miss Annie J. Cannon.
Councillors 1912–1914—W. W. Campbell, E. B. Frost.

The councillors who continue to serve are:

Councillors 1911–1913—W. S. Eichelberger, J. S. Plaskett.

Abstracts of the committee reports and forty-six papers which were read follow:

Irregularities in Atmospheric Refraction: FRANK SCHLESINGER.

This investigation was suggested by the recent work of Nusl and Fric at Prague, who found evidence of irregularities in refraction in a period that is roughly one minute, and having considerable amplitude. At the present author's request Professor Slocum, of the Yerkes Observatory, kindly secured with the 40-inch refractor a number

of plates showing trails of the Pleiades. These plates were exposed on several different nights. Proper precautions were taken to leave the telescope as undisturbed as possible. The trails were measured at the Allegheny Observatory by setting the micrometer wire on the mean position of successive portions of the trail, each corresponding to an interval of about three seconds of time. It was found that on each evening the trails conclusively show the presence of irregular refractions, portions of the trails remaining on one side (of the mean position for that plate) sometimes nearly a minute. On two of the plates simultaneous trails of Alcyone and Merope were measured and these show a remarkable parallelism. The result of this experiment tends strongly to confirm the deductions of Nusl and Fric.

The Orbit of R Canis Majoris: Frank C. Jordan.

This star, one of the few Algol variables with an advanced type spectrum, *F*, was discovered to be a light variable, by Sawyer in 1887, and to have variable radial velocity, by Frost in 1905. Forty-nine plates have been obtained at Allegheny in five seasons of observation. The light period has been very accurately determined and is taken as the definitive orbital period.

The elements are as follows: $P = 1.13595$ days; $e = 0.138$; $\omega = 195°.86$; $K = 28.64$ km.; $\gamma = -43.45$ km.; $T = 1908$, Jan. 25.296, Light Minimum; $a \sin i = 453{,}500$ km.; $m'^3/(m + m')^2 = 0.00288$ $\odot$.

Accurate photometric observations combined with the orbital elements, and the fact that the spectrum is much like that of our sun, will give an independent means of finding the star's parallax.

New Eclipsing Variable Stars: Joel Stebbins.

It is probable that a considerable number of the short-period spectroscopic binaries are eclipsing variable stars, and the writer reports progress on tests of these systems with the selenium photometer. It seems practically certain that α Virginis and α Coronæ Borealis are such variables, and β Scorpii is suspected. The first, Spica, has a period of 4.014 days, and shows two minima, a primary of something greater than 0.10 mag., and a secondary of about 0.08 mag. The main eclipse of α Coronæ was observed only once, but it was a decrease of at least 0.12 mag., and came at the predicted time. This star is a member of the extended Ursa Major group, and has a period of 17.36 days. The suspicions of the variation of β Scorpii seem well founded, but need confirmation.

The results emphasize the urgent need of further tests on similar stars.

The Scale of the Durchmusterung: E. C. Pickering.

The number of stars in the Bonn Durchmusterung is about 460,000; in the Cordoba, 490,000; in the Cape, 450,000; total, 1,400,000, or, omitting duplicates, 1,100,000 stars. In the *Harvard Annals*, **23**, the deviations, from the photometric scales, of the magnitudes 9.0 and brighter are discussed. Volumes **70** and **74** permit a similar study of the fainter stars and of those in the Cordoba Durchmusterung whose average brightness differs as much as a magnitude in different hours, the brightness increasing as the number of stars per degree increases. The photometric magnitude of Bonn 9.5 is 10.5; of Cordoba 10 it is 12.0 in zones $-22°$ to $-42°$, and 11.7 in zones $-43°$ to $-52°$. Stars of a given Durchmusterung magnitude are half a magnitude brighter in zones $-43°$ to $-52°$ than those in the zones $-22°$ to $-42°$.

The deviations of the Cape Durchmusterung magnitudes from the photometric magnitudes are reduced one half by grouping stars on the same plate and applying a correction for the class of spectrum. The average deviation in a provisional reduction of 12 plates is only ± 0.2 mag.

The Progress of the Revised Draper Catalogue: Annie J. Cannon.

The purpose of this catalogue is to give the class of spectrum of all stars down to about the eighth magnitude, distributed over the entire sky. Photographs having exposures of sixty minutes have been made at Cambridge and Arequipa with a prism of small angle placed before the objective of 8-inch doublets, and all stars will be classified which are bright enough to be seen clearly and have not already been published in *H. A.*, **28**, and *H. A.*, **56**, 4 and 5. Besides the classification the catalogue will give the photographic magnitude, the identification in some position catalogue, and the place for 1900. The catalogue was started in October, 1911. With an hour's observation each day, about 5,000 spectra can be classified in a month. This rate has been maintained since February, 1912, so that at the beginning of August, 45,000 stars have been classified. Charts were exhibited showing that about one third of the sky has been covered.

A Design for a New Form of Spectrograph Collimator: Philip Fox.

This form was proposed for use with the small

quartz spectrograph of the Yerkes Observatory. As the spectrograph was to be used with the 2-foot reflector, of which the angular aperture is $f/4$, the collimator should also have such ratio. The form proposed is in all essentials a small reflector of the cassegrain form. The light coming through the slit falls on the perforated concave mirror, which throws the light upon a small perforated convex mirror, mounted just back of the slit. This second mirror is of such curvature that it throws a parallel beam through the perforation of the first mirror upon the prism. The ratio of perforation to aperture in both cases is equal to the ratio of aperture of the objective of the telescope to the diagonal mirror, and the aperture of the convex mirror is equal to the perforation of the concave, so there is no loss of light. The perforation of the convex mirror centered behind the slit is of sufficient size to permit the use of a slit one eighth of an inch long.

Systematic Motions of the Stars: BENJAMIN BOSS.

Diagrams representing the distribution of stars of the different spectral types and down to the 6.5 magnitude were exhibited. The striking preference of the *B* type stars for the plane of the galaxy, the similar, though somewhat less pronounced, preference of the *A* type for the same plane, and the more random distribution of the more advanced types was clearly shown. We must either conclude that eventually a state of approximately random motion must prevail, or that the later type stars originated uniformly over the entire sky, rather than selecting the plane of the galaxy. The facts revealed by the study of the motions of the stars indicate that the first view is the correct one (*A. J.*, 635–636). The early type stars show a decided crowding toward certain portions of the galaxy, toward the vertices of preferential motion, as discovered by Kapteyn, and toward the apex and antapex of a group of stars called Group IV., or the antapex group, discovered by the writer (*A. J.*, 635). That the motion of this group is in the direction of the antapex of solar motion, and that there seems to be a tendency of motion in the opposite direction, may indicate the existence of a solar group. The analysis of the motions within these groups is now in process of development by the writer.

Observations of Variable Stars at the Vassar College Observatory: CAROLINE E. FURNESS.

Observations of variable stars were begun at this observatory in 1901. The telescopes in use had apertures of twelve, five and three inches. A photographic wedge photometer which could be attached to the twelve-inch was in use for part of the time, but for the most part the comparisons were made by the Argelander method. The observing list included chiefly long-period variables which were selected so that they might pass through a maximum or minimum during the time of observation. The predictions were usually taken from Hartwig's ephemeris. The standard of magnitude was the Harvard photometry, other sources being reduced to this scale.

The resulting observations, about five thousand in number, with a full discussion of the curves and periods of the stars so far as they may be determined, are to be published as soon as their revision is complete.[1]

On the Cause of the Earth's Magnetic Field: L. A. BAUER.

The communication is confined to a consideration of the portion of the field which is symmetrical about both the axis of rotation and the equator. If the intensity of the magnetization be computed for each parallel of latitude over the region best covered by magnetic observations, 60° N. to 60° S., on the basis that the average values of the observed magnetic components along a parallel correspond to those of a uniform magnetization parallel to the axis of rotation, then a systematic and regular increase in the intensity is observed in both hemispheres with approach to the equator. This may be stated mathematically thus: If X be the magnetic component along a true meridian, positive toward the north, and Z be the vertical component, positive downward, then for the field, symmetrical as stated, the components, for any co-latitude u, will be

$$X = f_x(u) \sin u \quad \text{and} \quad Z = f_z(u) \cos u.$$

These "characteristic functions" show an increase of 13 to 17 per cent. from the parallel of 60° to the equator.

None of the theories thus far advanced to account for the origin of the earth's magnetic field gives the law of the observed increase in the characteristic functions. With but few exceptions, the attempts have been restricted to ascertaining a cause for a uniform magnetization. Since this course has not led to generally accepted results, it was decided to begin with the geographical variations, hoping that, if their cause be determined, valuable clues might be found as to the origin of the primary field. Thus a closed physical expres-

[1] See *Popular Astronomy*, **20**, 645, 1912.

sion was found, consisting of the zonal harmonics of the first and third order, which represents the facts to within one per cent.

Supposing the bound electrical charges in each atom of the earth to be separated by some cause into positive and negative atomic charges an infinitesimal distance apart, such that the total charge throughout the earth of each kind of electricity be equal and the volume density of each charge vary from parallel to parallel as $\sin^2 u$; then, by reason of the earth's rotation, a magnetic field results whose potential is the expression mentioned in the preceding paragraph. The first term corresponds to a uniform magnetization of the earth parallel to its axis of rotation having about one tenth of the strength of the total portion assignable to a uniform field; the second term, consisting of the third order harmonic, reproduces satisfactorily the observed increase in the characteristic functions. If it be assumed that the separating agency is the component of the earth's centrifugal force acting in the direction of the radius away from the center, a distribution of the two opposite electricities throughout the earth would apparently result, following, as a first approximation, the same law of density, supposed in deriving the expression, the zonal harmonics. Before a final statement, however, can be made as to the precise cause, a more complete examination will have to be made and full consideration be given to all the various effects involved.

Radial Motion in Sun-spots: C. E. St. John.

The results obtained to date indicate the following mean conditions:

Element	Line	Intensity	Direction	Vel. in Km. per Sec.
Ca	H, K		Inward	2.5
H	Hα		Inward	1.4
Na	D		Inward	0.2
Mg	b		Inward	0.3
Al	λ 3961	20	Inward	0.1
Fe	Mean of several near λ 5200	6	Outward	0.40
Fe		5	Outward	0.43
Fe		4	Outward	0.52
Fe		3	Outward	0.61
Fe		2	Outward	0.66
Fe		1	Outward	0.75
Fe		0	Outward	0.84

Results similar to those of iron appear for other metallic vapors producing lines of moderate intensities, though the velocities from lines of equal intensities for different elements are not equal. This offers a means of determining the relative levels at which lines of different intensities have their origin, in terms of some standard such as iron.

Three regions are indicated in the solar atmosphere surrounding spots with the following characteristics at the different levels: (1) The upper chromosphere, motion inward, shown by the H and K lines of calcium and H_α of hydrogen; (2) an intermediate region shown by the D lines of sodium, b lines of magnesium, and the strong aluminum and iron lines, motion inward generally prevailing; (3) a lower region of outward motion, velocity increasing with lower levels, on the assumption that when considered by and large the weaker lines are associated with the lower levels.

Pressure in the Solar Atmosphere: C. E. St. John.

In the new spectrograph of the 150-foot tower telescope the sources of error associated with the instability of the apparatus, the illumination of the grating and the centering of the solar image, have been overcome, the first, by the massive construction of the spectrograph, the head of which weighs about 4,500 lbs.; the second, by the larger diameter, 15 inches, of the cone of sunlight incident upon the grating which the long focus, 75 feet, of the spectrograph permits when the 12-inch objective of 60-feet focus is used to form the solar image on the slit; the third, by fixing the slit rigorously on the axis of the centering circles. The error introduced from non-centering of the image may be large; with the image now used (diameter 162 mm.) the solar lines would be shifted 0.001 Å. by solar rotation when the slit is 2 mm. from the center of the image and on small images the error might be much greater.

With this equipment an investigation involving a comparison of the arc and solar spectra of iron is being carried out. The preliminary results show that the solar lines of iron classified in accordance with their displacement in solar spectrum fall into the classes suggested by Gale and Adams in their study of pressure shift under laboratory conditions and indicate pressures in the solar atmosphere varying from 0.7 to 6.5 terrestrial atmospheres for the different groups.

On the Diurnal Variations of Atmospheric Pressure: W. J. Humphreys.

It has been known for nearly two and a half centuries that there are more or less regular daily variations in the height of the barometer, culminating in two maxima and two minima during the course of the 24 hours; the maxima occurring

at 10 o'clock, roughly, forenoon and evening, the minima at 4 o'clock, roughly, afternoon and morning.

All that is needed, apparently, to give the semi-diurnal pressure curve, is a pressure impulse of the same period, 12 hours, as that of the free vibration of the atmosphere as a whole. And this, it seems, is furnished by a forced forenoon barometric maximum, due to the interference of vertical convection with the free flow of the air, followed, six hours later, at the same place by a forced afternoon barometric minimum, caused by expansion and overflow. In other words, taken together the forenoon and afternoon forced disturbances appear to occur with the proper time interval necessary to set up and maintain the 12-hour free vibrations of the atmosphere.

The course of events at each locality, affecting the height of the barometer, appears to be substantially as follows: (1) A forced forenoon compression of the atmosphere followed by its equally forced afternoon expansion; both due to a single heating and the two together forming one complete barometric wave, with a 10-o'clock maximum and a 4-o'clock minimum, in harmony with the free vibration of the entire atmosphere shell. (2) Non-disturbance through the night, or during the period of a single free vibration. (3) Repetition the following day of the forced disturbances in synchronism with, and therefore at such time as to reinforce, the free vibrations. The series of disturbances of course is indefinitely great, alternately forced and alternately free, but the resulting amplitudes of the barometric changes are limited, through friction and through the absence of perfect synchronism, to comparatively small values.

A Screen for Equalizing Star Magnitudes for Transit Circle Work: F. B. LITTELL.

The equalizing screen consists of two sets of thin brass slats at right angles to each other, intermeshed to form a rectangular, honeycomb structure. The slats are 1/2 inch wide, 1/120 inch thick and 1/5 inch apart, and make an angle of 45° to the plane of the meridian. The whole is mounted about 3 inches in front of the objective and may be tilted about an axis parallel to the horizon, the operation being effected and the amount read at the eye end. The light which falls on the objective is evenly distributed in nearly rhombic areas. A tilt of 30° gives total extinction. The bright spectral images formed by the bright stars which vary in character with the setting of the screen can be rendered practically invisible in a bright field by preliminarily reducing the light by means of one or both of the two wire mesh screens which have been used on the instrument for several years and which are retained for this purpose.

24-inch Objective of the Sproul Telescope: J. A. MILLER and R. W. MARIOTT.

The 24-inch objective for the Sproul telescope by the John A. Brashear Co. was completed and mounted in the Sproul Observatory of Swarthmore College in December of 1911. This paper discussed the quality of this objective as determined by the Hartmann method. In February of 1912, extra focal exposures on Capella were made through a screen containing 44 circular holes, 33 mm. in diameter, so arranged as to cover 9 zones of the lens. The exposures were made on Cramer Instantaneous Isochromatic plates. A yellow ray filter made by Wallace in accordance with the color curve of the objective was placed in front of the plate and almost in contact with it. Later a set of extra focal exposures were made on Arcturus in the same way. In the meantime, however, a spring holding the lens in its place in the cell was slightly loosened. The exposures on Arcturus were through a screen containing 78 circular holes of 25 mm. diameter, so arranged that it covered 10 zones. The measure demonstrated that qualitatively the two tests showed slight axial stigmatism, at approximately the same points in the lens. Hartmann's characteristic T for the Arcturus test is 0.270 and for the Capella test, 0.274, showing that the lens is an excellent one.

The Orbits of 44 Eclipsing Binaries: HARLOW SHAPLEY.

Using the methods recently developed by Professor Russell, orbits have been computed for all eclipsing variable stars for which there exists reliable photometric data. Included in the material discussed are unpublished observations made by the writer with the Princeton polarizing photometer of the stars *RZ* Draconis, *RX* Draconis, *RR* Draconis, *WZ* Cygni, *AE* Cygni, *ZZ* Cygni, *RW* Capricorni, *RX* Herculis and *RW* Monocerotis. The periods of a few stars have been redetermined. Secondary minima have been found from an analysis of maximum light observations in the cases of *U* Cephei, *R* Canis Majoris, *RZ* Draconis, *ST* Carinæ, *SU* Centauri and *SZ* Centauri, and possibly for *S* Cancri, *δ* Libræ and *RW* Monocerotis. The investigation of the light curves of

U Ophiuchi, *RZ* Centauri and *SZ* Centauri shows that the periods of these variables are double the values heretofore given, for in each case two minima of unequal depth alternate. This is also probably true for *SS* Carinæ and for *RX* Draconis.

For more than 80 per cent. of the orbits studied circular elements represent the observations satisfactorily. In no instance has an orbital eccentricity been found to exceed 0.1. The fainter component is very generally the larger of the pair. In only one case out of nine is the dark companion definitely smaller. Pairs of equally luminous stars are rare; equal radii are more common.

The elongations of the component stars through gravitational interaction has affected the shape of the light curves for one third of the number here considered to a degree sufficient to be taken into account in the discussion of the orbits. The square of the eccentricity of a meridian section of the assumed similar prolate spheroids is greater than 0.30 for β Lyræ, *RS* Sculptoris, *RR* Centauri and *V* Puppis; it is greater than 0.20 and less than 0.30 for *U* Pegasi, *U* Scuti and *u* Herculis; and between 0.10 and 0.20 for *U*. Ophiuchi, *V* Serpentis, *RZ* Centauri and *SZ* Centauri. These data have enabled the comparison of the *observed* relation between the prolateness and distance of centers with the *theoretical* relation derived by Darwin for equal masses of homogeneous, incompressible fluid. A remarkable agreement is found.

The densities of the pairs were computed in terms of the sun's density, on the assumption of equally massive components. An important relation is found connecting density and spectral type. The average density of nine stars of Classes *B*1 to *B*8 is 0.16; of 26 stars of Class *A* it is 0.13; but for eight stars of Classes *A*5 to *F* the average is 0.55. No star of the first two groups has a density as great as one half that of the sun; and the solar density is not exceeded by any in the third group.

A general investigation has been made in connection with Professor Russell of the theory of darkening at the limb in eclipsing variables and of the relation existing between orbital elements derived on the assumption of uniformly illuminated disks and of disks darkened to zero at the limb. Tables analogous to those used in deriving elements on the former assumption have been constructed.

On the Graphical Representation of Eclipsing Variables: Henry Norris Russell.

The computed elements of an eclipsing variable are admirably adapted for graphical illustration. A diagram of the system as seen from the earth exhibits at a glance all the geometrical elements. By a proper choice of scale, it may be made to show much more. If we assume that each component is equal in mass to the sun, their mean distance (in solar radii) will be $5.29\ P^{2/3}$, where P is the period in days. If platted on this scale, the radius of the orbit will at once indicate the period, and those of the individual stars their probable densities (on the usual assumption of equality of mass). By suitable shadings, the relative surface brightness may also be indicated, and thus practically all the facts for several systems may be displayed on a single sheet.

Such diagrams also give, in all probability, a very good idea of the actual dimensions of the various systems. No stellar system has yet been reliably investigated whose mass is less than one fourth that of the sun; and masses exceeding sixteen times the sun's are very rare. It follows that the actual dimensions of a given system, compared with the sun, are very unlikely to be more than twice, or less than half, those indicated by diagrams prepared as above. Since most eclipsing variables are too faint for direct spectrographic investigation, this is probably the best way at present available of getting an idea of their real size.

Relation Between Spectrum and Color-index of 500 Stars: J. A. Parkhurst.

The revised data from the writer's forthcoming catalogue of magnitudes and spectra of northern stars[2] furnishes material for a curve showing the relation between spectrum and color-index. The range in magnitude of the stars used is between 4 and 9, the greater number lying between 6 and 8.5. The average magnitude is 7.3 visual, corresponding to 7.7 photographic since the color-index of the average star is 0.4. The Harvard classification is used.

Platting the color-index as abscissæ and the spectral class as ordinates, a straight line is found to fit the points better than any simple curve. The lantern slide accompanying the paper shows a comparison between this "curve" and those published by King in *Harvard Annals*, **59**, 180, and Schwarzschild in his Göttingen *Aktinometrie, B*, 19. King's stars are mostly brighter than magnitude 4.5, while Schwarzschild's are about the same brightness as those measured by the writer. The present work differs from the other

[2] *Ap. J.*, **36**, 169, 1912.

two, in that all elements used were determined by the same person and the same instrument.

The Attraction of Sun-spots for Prominences: FREDERICK SLOCUM.

In the autumn of 1910 a large group of sun-spots passed several times across the face of the sun. On its first passage, from August 2 to August 15, it was given the Greenwich number 6,874.

Active prominences were observed in the immediate vicinity of the spot group from August 2 to November 5, but the best displays occurred on the west limb on October 8, extending from Lat. $+6°$ to $-37°$, and on the east limb on October 22, extending from Lat. $+12°$ to $-36°$. Slides of calcium spectroheliograms of the spot, the surrounding flocculi and the attendant prominences were shown.

The prominences were pouring from both sides apparently right down into the spot. Points that can be identified on two or more plates give velocities along the apparent trajectory up to 110 km. per second, and show a marked acceleration towards the spot. The conclusion is that some sun-spots exert an attraction for the material of which prominences are composed.

No.	Star	π	P. E.	Remarks
1	ϕ Androm.	$+0''.014$	$\pm0''.017$	Visual binary.
2	48 Cassiop.	-0.001	±0.015	Visual binary.
3	20 Persei	-0.008	±0.006	Visual binary.
4	9 Camelop.	$+0.030$	±0.005	Spectroscopic binary.
5	μ Orionis	$+0.036$	±0.007	Spectroscopic binary.
6	Groningen VII. 20	$+0.129$	±0.012	Faint star with large proper motion.
7	*BD* 18°, 3424	$+0.004$	±0.014	Faint star with large proper motion.
8	17 Lyræ *C*	$+0.128$	±0.008	Faint star with large proper motion.
9	*P* Cygni	-0.014	±0.008	Nova?
10	τ Cygni	$+0.001$	±0.007	Visual and spectroscopic binary
11	Nova Lacertæ	$+0.011$	±0.013	Nova.

Stellar Parallaxes from Plates made with the Forty-inch Refractor of the Yerkes Observatory: F. SLOCUM and S. A. MITCHELL.

The present parallax program contains about 150 fields, including (*a*) stars with large proper motion, (*b*) stars with large radial velocity, (*c*) binaries, visual and spectroscopic, (*d*) selected stars of the different spectral types, (*e*) novæ, and stars in any way peculiar, (*f*) the Kapteyn zone $+45°$. The following parallaxes have recently been determined:

The average number of plates used for each of the above determinations is eleven, the average number of comparison stars, five, and the average magnitude of the comparison stars, 9.6. Numbers 3, 4, 5, 9 and 10 were measured and reduced by Professor S. A. Mitchell, of Columbia University, and numbers 1, 2, 6, 8, 11 by Professor Slocum, and number 7 by Miss M. M. Hopkins, of Smith College.

The Spectrum of Nova Geminorum No. 2 on March 13, 1912: R. H. CURTISS.

The Detroit Observatory slit spectrograms of Nova Geminorum II. secured on March 13, 1912, show characteristics which have important bearing on the nature of the spectral changes of a nova as it approaches its maximum radiance. The nova's spectrum on this date strongly resembles that of March 15, when the nova maximum type was generally recognized, the peculiarities of the light on the earlier date being strongly accentuated two days later. The conclusion is suggested that the peculiarities of the nova type appeared in the spectrum of this star earlier than has been supposed.

The Plane Grating Spectrograph for Stellar Work: J. S. PLASKETT.

This paper gives a short account of some preliminary tests on the use of a plane grating as the dispersion piece of a stellar spectrograph. The grating with ruled surface $2\frac{7}{8}$ by $3\frac{3}{4}$ inches, 15,000 lines to the inch, was specially ruled to give great concentration and it is estimated that 50 per cent. of the incident light is diffracted into the first order on one side. The spectrograph has been tested only in the Littrow form, with a $2\frac{1}{2}$-inch Brashear Triplet of $37\frac{1}{2}$-inch focus, giving a linear dispersion of about 17.5 Å. per mm. at H_γ. It gives beautiful definition and a field very nearly flat over the range used from $\lambda4800$ to $\lambda3500$. The relative intensity of star spectra obtained with this instrument, and the Ottawa three-prism spectrograph with a camera objective giving the same dispersion at H is as follows: Region $\lambda4700$–$\lambda4300$, prismatic about twice as intense as diffraction spectrum. Region $\lambda4300$–$\lambda4200$, spectra of nearly equal intensity. Region $\lambda4150$–$\lambda4100$, diffraction two to three times as intense

as prismatic spectrum. Region λ4100–λ3850, diffraction spectrum of nearly uniform intensity and nearly as strong as at H_γ. Prismatic spectrum, none. It is evident that with this dispersion the diffraction spectrograph is superior, especially towards the violet and ultraviolet. When it is compared with a single prism spectrograph of lower dispersion the advantage will likely be the other way, but if a spectrum of uniform intensity over a wide range is required, and in the red end, where the prismatic spectrum is unduly compressed, the grating spectrograph will undoubtedly possess many advantages. As soon as possible a more complete test of its performance will be made.

The Cincinnati Astronomical Society: DeLisle Stewart.

This paper describes the organization and activities and plans of the society. The suggestion is made that some definite connection between the national and local societies might be worth consideration.

Radium and the Chromosphere: S. A. Mitchell.

This paper has been published in *A. N.*, 4600, so only the conclusions need be given here.

At the 1905 eclipse, while a member of the U. S. Naval Observatory expedition in Spain, the writer photographed the "Flash Spectrum" with such dispersion and definition that it permitted the determination of wave-lengths which are in error but a few hundredths of an Ångstrom. A comparison with the radium spectrum showed that a majority of the lines due to radium nearly coincide in the chromosphere with lines already satisfactorily identified from other sources. The third strongest line of radium at λ4826.10, if present in the chromosphere, must be very weak. The comparison between the spectra of radium and of radium emanation and the chromosphere has led me to the conclusion that there are no radium lines in the sun. A similar lack of uranium lines likewise appears.

It will be necessary to obtain photographs of novæ with a much greater dispersion than that used at Bonn before deciding that radium or uranium lines are found in their spectra.

Absorbing Medium in Space: Edward S. King.

The results given in *Harvard Annals*, **59**, indicated the presence of an absorbing medium in space. The amount found was 0.0377 mag. for the photographic rays, and 0.0184 mag. for the visual rays, while traversing the unit of distance, which is measured by 32.6 light-years.

These figures having been derived from 26 stars, it was thought best to improve the data by applying the method to other stars. Accordingly, a supplementary list of 22 stars was prepared from the *Publications of the Groningen Laboratory*, No. 24, and observed. The procedure was in all respects precisely that followed previously. The resulting values had the same sign, indicating absorption by greater redness, but were somewhat larger than before. By selecting from both lists only those stars having the parallax most accurately determined, the reduction gave values identical with the above results from *Harvard Annals*, **59**. Thus, the indications from this work also point to the presence of an absorbing medium in space, or some factor which produces effects similar to absorption by making the more distant stars appear redder.

Proper Motions of Faint Stars: George C. Comstock.

The writer, who has been engaged for some years upon a study of the motions of the faintest stars for whose determination adequate material can be found, presents in this paper results relating to more than 250 stars fainter than the tenth magnitude of the Harvard scale. These motions have been derived from micrometer observations by which the positions of the faint stars are referred to neighboring brighter ones of known proper motion, the time interval covered by the measures being in a few cases as small as a quarter century but more frequently extending to fifty or seventy-five years. The probable error of the motion assigned each star in each coordinate has been determined, and from a comparison of these numbers with similar data given in Boss's Preliminary General Catalogue it appears that the proper motions here considered, tenth to thirteenth stellar magnitude, are at least of equal precision with those given for the fainter stars of the Boss Catalogue, 7.5 to 9.0 magnitude. The proper motions here considered are all referred to the Boss system.

In a certain number of cases the motions here investigated are shown to be orbital, the faint star being physically connected with its brighter companion; but when the angular distance separating the stars exceeds the Struve double-star limit of 32″ this connection is found to be very infrequent and in about 80 per cent. of the cases here investigated, *i. e.*, more than 200 stars, the motion of the faint star appears to be uninfluenced by its

brighter companion. Frequency curves showing the distribution of total proper motion and of motion in both right ascension and declination were exhibited and certain suggestions relative to the structure of the stellar system were derived from them; *e. g.*, the mean motion of these stars, about 3″.5 per century, is larger than has usually been supposed, indicating a smaller total extent than is commonly attributed to the sidereal universe. A general southerly drift, shown by these stars, suggests that in great part they lie outside a group associated with the sun and comprising a large part of the brighter stars. The precession constant furnished by these faint stars is shown to be in excellent agreement with that found by Boss from the brighter stars, implying that these bright stars possess, as a whole, no motion of rotation about the earth's axis that is not shared by the fainter stars.

A curious empirical relation, long known but little heeded, is confirmed and considerably extended by these results, viz., the product, stellar magnitude multiplied by proper motion, is approximately constant over all magnitudes from the second to the eleventh, inclusive, and unless there are conditions of the problem not now apparent this relation would imply that in the average of a large number of cases a star's distance from the sun is proportional to its numerical magnitude. This suggestion is probably of too revolutionary character to be readily accepted, although it is paralleled by the conclusion reached by Campbell from spectroscopic evidence that the stars of different magnitudes are more thoroughly intermixed in space than has been commonly assumed.

The Solar Eclipse of April 16, 1912, as Predicted and as Observed: ARTHUR NEWTON.

The Nautical Almanac Office is preparing for the press the final installment of Professor Simon Newcomb's "Researches on the Motion of the Moon." Corrections therein given have been applied in the American Ephemeris and Nautical Almanac for 1912 to the moon's position in the computation of the two solar eclipses of the present year.

The many observations made on April 17 are entirely confirmatory of the accuracy of these final values by Professor Newcomb. The American Almanac gave a predicted time of occurrence that was within two seconds of the mean observed time. The European almanacs were in error from 15 to 30 seconds. The central line of eclipse was placed about one mile too far to the northwest by the American Almanac, and much farther in the same direction by the other almanacs, with the exception of the French.

These results indicate that the moon's position as employed in the American Ephemeris for this eclipse required a further correction of $+1''.0$ to the longitude and of $-0''.5$ to the latitude. The prediction was further borne out in the phase which was total in Portugal and Spain with a maximum duration of one second, and annular in France with a duration of three or four seconds at Paris. The indicated correction to the adopted semi-diameter of the moon is less than 0″.2.

A Method of Approximating Rainfall over Long Periods and Some Results of its Application: A. E. DOUGLASS.

It was found by a test extending over 43 years that the radial thickness of the rings of the yellow pine of northern Arizona gives a measure of the rainfall in that vicinity with an average accuracy of over 70 per cent. By applying a simple formula, taking into account the conservation of moisture, the accuracy may be increased to about 75 per cent. By cross identification of rings between all the hundred trees examined, the accuracy of counting rings was greatly increased.

Five trees from the vicinity of Flagstaff were measured to the number of 400 rings, and two of these to 500. It was found that all the trees in that locality gave very similar records. A 21-year variation amounting in all to 20 per cent. of the mean is shown in 400 out of the 500 years recorded. A shorter variation amounting to 16 per cent. of the mean was found to have a period of 11.4 years. Its plot derived from 492 years shows 2 maxima which correspond in time with 2 maxima of rainfall in the 50 years of records on the southern California coast. These in turn match the major and minor maxima in the temperature of that region for the same period. The larger maximum of the latter occurs at the time of the sun-spot minimum as averaged for 125 years.

The Algol Variable RR Draconis: F. H. SEARES.

The writer made an attempt to determine the light curve of this star from observations with the 7½-inch refractor of the Laws Observatory. On account of its faintness it could not be followed through the minimum. On August 7 the star was followed photographically through an eclipse with the 60-inch reflector of the Mt. Wilson Observatory. Sixty-five exposures, covering an interval of 6 hours, were obtained. The variable is normally of 9.70 mag. There is an interval of

constant minimum brightness, lasting about 1½ hours, during which the magnitude is 13.50. The duration of eclipse is 8½ hours. The light change is very rapid, the last magnitude of the descent is accomplished in 20 minutes. For two magnitudes of the descent the visual and photographic curves are in close agreement, but from this point the photographic variation seems more rapid than the visual. For $\Delta m = 3.25$ mags. visually, the photographic value is 3.50. This greater photographic range is probably real. The observed time of minimum was eleven minutes late of the ephemeris from the elements of the Laws Observatory Bulletin No. 9, indicating a correction to the period, which is slightly less than $2^d\ 20^h$, of less than a second.

Spectrographic Observations of ϕ Persei: Frank C. Jordan.

This star has been known, since 1889, to have a bright line spectrum. About 400 spectrum plates have been obtained by various observers, and its period determined as 126.5 days. The hydrogen lines are constituted as follows: A broad, weak, underlying absorption, upon which is superposed a broad emission line appearing as two because of a central narrow and strong absorption. The sharpness and strength of the absorption lines varies strikingly in different parts of the orbit, becoming at one phase so weak and diffuse as to be almost immeasurable. Helium lines show only at certain phases. There are visible at least twelve other bright lines which seem to be constituted like the hydrogen lines, and to give the same velocity as these lines.

The velocity curve is peculiar in that at about one third of the period from maximum positive velocity there is a decided hump. The highest velocity is + 44 km. It goes down to — 7 km. at phase 24 days, up to 0 km. at phase 35 days, then down to a minimum of — 21 km. at phase 75 days. In different revolutions of the system the velocity curves do not seem to be the same either in shape or amplitude.

Preliminary measures on the bright hydrogen lines give a velocity curve different from that of the absorption lines, but not such a curve as would be given by a secondary body.

Spectrographic Observations of Algol: Frank Schlesinger.

Algol has been upon the observing list for the Mellon spectrograph during the past six years. A total of 336 spectrograms have been secured, and have been measured and reduced by the author under as uniform conditions as possible. A study of this material yields the following chief results: (1) The long period oscillation in the radial velocities, announced by Belopolsky in 1906, is unmistakably confirmed. This oscillation has a period of 1.874 years and a semi-amplitude of 9.14 km., and is in an orbit whose eccentricity is small. (2) Such an oscillation should be accompanied by a similar oscillation in the times of light minimum, the latter sometimes occurring as much as 5 minutes in advance and sometimes 5 minutes after the predicted epochs. An examination of the rich photometric material on this star obtained in the years from 1852 to 1887 brings out this small term with almost precisely the amplitude computed from the spectrographic measures. (3) The eccentricity of the short-period orbit (2.87 days) comes out small, very probably less than 0.02. This seems to make it necessary to reject Tisserand's explanation for Chandler's long-period term (141 years) in the times at which light minima occur, since this explanation demands an eccentricity in the neighborhood of 0.13. A renewal of photometric observations of Algol is much to be desired, as well as a rediscussion of all the available data of this kind.

The Orbit of λ Tauri: Frank Schlesinger.

Eighty-nine spectrograms of this bright Algol variable have been secured with the Mellon spectrograph at the Allegheny Observatory. These yield the following elements of its orbit: period (assumed from photometric data), 3.9529 days; semi-amplitude 58.1 km. $\pm$ 1.08 km.; eccentricity, 0.053 ± 0.017; longitude of periastron, $111°.6 \pm 20°.5$; time of periastron passage, 0.31 days after light minimum $\pm$ 0.23 days; mean velocity, + 13.6 km.

The lines in the spectrum of this star are affected by shadings alternately on their red and violet sides. These can not be due to the presence of the fainter spectrum, since they are too close to the lines of the bright spectrum to permit of this explanation. The spectrograms are all upon plates of fine grain.

The Magnitude Scale of the Polar Sequence: F. H. Seares.

The methods of photographic photometry employed with the 60-inch reflector of the Mt. Wilson Observatory involve the use of a wire gauze screen and diaphragms of various apertures. The most troublesome difficulty has been the determination of the error depending on the distance of the stars from the axis of the instrument which varied

from plate to plate and with direction on the same plate. The erratic variations seem now to be eliminated. At present, the point of greatest interest in photographic photometry relates to the determination of an absolute scale. The first determination of magnitudes has been for stars of the polar sequence. Fifteen plates with the wire gauze screen and diaphragms of 32 and 14 inches, affording 27 separate determinations of the scale, have been used. The exposures range from 1 to 11 minutes, the magnitudes from 8.8 to 17.6, although the limits for reliable results are 10.5 to 15.5. The mean deviations of groups of stars from results obtained at the Harvard Observatory are as follows:

Magnitude	Mt. W.–H.	No. Stars
8.81	+ 0.11	1
10.5 — 11.5	— 0.03	6
11.5 — 12.5	— 0.02	4
12.5 — 13.5	+ 0.03	6
13.5 — 14.5	+ 0.03	5
14.5 — 15.5	— 0.01	5
15.5 — 16.5	— 0.13	4
16.5 — 17.5	— 0.27	7

The zero point of the Mt. Wilson scale is such that the sum of the deviations from the Harvard scale between 10.5 and 15.5 is zero. The cause for the divergence beyond mag. 15.5 is not yet established, but may be settled by comparing the scale here given with that derived from plates of longer exposure.

Variable Asteroids: S. I. BAILEY.

In connection with the photometric measurements of Eros, made at Arequipa in the years 1902 and 1903, observations of Ceres, Parthenope, Massalia, Kalliope, Urania, Harmonia, Melete, Hecuba, Sirona, Baucis, Celuta, Chryseis, Kallisto, Kleopatra, Germania, Bamberga, Tercidina, Melusina, Ilmator, Aquitania, Aurelia, Eros and Tergeste, were undertaken especially for the detection of new cases of variability in light. The Rumford photometer was used with the 13-inch Boyden telescope. Five cases of variability, in addition to Eros, were detected: Urania (30); indications of variability, no satisfactory period found. Hecuba (108); indications of a small range of variation, having a period which appears to be a sub-multiple of $0^d.99$, perhaps $0^d.330$. Sirona (116); indication of range of half a magnitude with period $0^d.403$. Celuta (186); variation small, if real, period $0^d.364$ satisfies all observations. Tercidina (345); small variation, satisfied with period $0^d.366$.

The light curves of Eros independently determined by the Rumford photometer and by photographs made with the Bruce telescope agree closely, but those obtained with the photographs have the smaller accidental errors. The photographic method offers many advantages. In order that photographs shall serve for the accurate determination of magnitudes, it is very desirable that the images of the asteroids shall be comparable with those of the stars. This can be accomplished by giving to the plate, while the telescope is moving at sidereal rate, a motion equal to one half the apparent motion of the asteroid.

Results of Latitude Observations at the Flower Observatory from December, 1904, to July, 1911: C. L. DOOLITTLE.

The series here considered consists of 13,852 determinations of latitude made with the zenith telescope, and 11,591 with the Wharton reflex zenith tube. All of the observations were made by myself and the two series are practically simultaneous. A comparison of the results given by the two instruments furnishes data, to be found nowhere else, so far as I know, for examining the daily fluctuations to be found in all extended series of this character.

For this purpose we have 1,540 comparisons. We find 149 cases where the residuals from both series are at least twice the probable error. Of these, 79 have like signs and 50 unlike. There are 12 cases where both residuals are at least three times the probable error; 10 of these have like signs. In these cases the residuals are four times the probable error and in one case six times the probable error. All of these have like signs.

It is obvious that we have to do with a class of errors other than those due to observations, and that before much greater progress can be hoped for in this direction, means must be found for this elimination.[3]

The Constant of Aberration: C. L. DOOLITTLE.

From the observations carried on at the Sayre and Flower Observatories from December 1, 1889, to June 8, 1911, with the zenith telescope and the reflex zenith tube there have been derived 22 values of this constant. Although these range in value from 20″.448 to 20″.605, the computed value of the probable error in no case differs very much from 0″.01. If we give all equal weight we have

[3] See *A. J.*, 641.

for the arithmetical mean of all, $20''.526 \pm 0''.0057$. There are, however, very good reasons for assigning higher weights to some of the 22 values than to others. The results have been derived from observations at two different places with practically four different instruments. We find, however, for the weighted means practically the same value as that given above, $20''.525 \pm 0''.0045$. The corresponding value of the solar parallax is $8''.780$.[4]

A Test of the 18½-inch Objective of the Dearborn Observatory Telescope: PHILIP FOX.

It has been interesting to apply Hartmann's test to this objective, the high quality of which is established by the long series of difficult double-stars which have been discovered with its aid by both Burnham and Hough. The perforated screen contained 96 holes, 12 mm. in diameter, arranged on 24 zones. The resulting curve of zonal foci is very smooth. The extreme range in focal length for the different zones is about 2 mm. The mean of the two sets gives for the Hartmann criterion T, the result $T = 0.30$.

Some Results from the Personal Equation Apparatus of the 9-inch Transit Circle of the U. S. Naval Observatory: W. S. EICHELBERGER and F. B. LITTELL.

With a personal equation apparatus the following results were obtained for the three observers, *L, M, P,* positive corrections indicating that the observer anticipates.

CHRONOGRAPHIC OBSERVATIONS

δ	Sec δ	*L*		*M*		*P*	
		RL	LR	RL	LR	RL	LR
		s	s	s	s	s	s
0°	1.0	−0.132	.....	−0.038	.....	−0.060	.....
39	1.3	−0.131	−0.136	−0.028	−0 038	−0.077	−0.100
62	2.1	−0.130	−0.167	−0.018	−0.045	−0 057	−0 112
82	7.4	−0.120	−0.188	−0.033	−0.058	−0 129	−0.153
85.1	11.7	−0.115	−0.203	−0.021	−0.037	−0.062	−0.112

EYE AND EAR OBSERVATIONS

85.1	11.7	+0.29	+0.23	+0.02	+0.05	+0.18	+0.23
87.7	24.9	+0.39	+0.29	−0.04	+0.18	+0.25	+0.27
88.9	52.1	+0.78	+0.64	+0.15	+0.26	+0.55	+0.68

Assuming that the personal equation can be represented by $p + m \sec \delta \pm n \sec \delta$, the coefficients were computed and corrections applied, thus reducing the errors to a very small quantity, generally less than $0^s.01$ for chronographic, and less than $0^s.05$ for eye and ear observations.

[4] See *A. J.*, 639, and Pub. Flower Observatory, Vol. III., 2.

Comparisons were made to test the reliability of these results, with satisfactory consequence.

A High-level Measurement of Solar Radiation: FRANK W. VERY.

Applying the methods elaborated in a previous paper, "The Violle Actinometer as an Instrument of Precision,"[5] to the reduction of an observation by M. Violle, who obtained from a sounding-balloon record at an altitude of 13,700 m. an excess of 53° in sunshine above an air temperature of 65° below zero Centigrade, the author obtained for the observed solar radiation-equivalent at 13,700 m., 2.86 gram cal./sq. cm. min. Making allowance for the absorbent atmosphere, deriving the value from the consideration of observations at sea-level, Keeler's and Nanry's on Mt. Whitney, Violle's on Mt. Blanc, the value of the solar constant obtained is 3.5 gram cal./sq. cm. min.

A Criterion of Accuracy in Measurements of Atmospheric Transmission of Solar Radiation: F. W. VERY.

The coefficient of atmospheric transmission of solar radiation on a given day is variable because of the variation of atmospheric extinction with zenith distance, and because this absorbent quality changes in the middle of the day, especially if much moisture is present. Thus in Bouguer's formula,

$$R = Ap^{\epsilon},$$

there are two variables p and ϵ, and the equation is soluble only by approximation.

To accomplish this approximation, M. Crova has proposed that the curve of radiation shall be considered as the envelope of a series of logarithmic arcs. By constructing successive subtangents to this envelope at points having values of ϵ for abscissæ, coefficients of transmission of the sifted rays, at stages corresponding to determined values of ϵ, can be found by the equation

$$T = e^{-\frac{1}{m(1+\epsilon)}},$$

where

$$m = \log\left(\frac{1+\epsilon_1}{1+\epsilon_2}\right) \div \log\left(\frac{R_2}{R_1}\right).$$

This procedure usually gives a series of varying values of m, so that a solution of the problem is no nearer, unless some occasion can be found when m does not vary appreciably. Such an extraordinary occasion is on record in the observation by Savélief at Kief, Russia, December 28,

[5] *Pub. A. A. S. A.*, **2**, 90.

1890, which may be used as a test by which less perfect measurements may be judged. By theory, we have the criterion that $1/m$ must always be a fraction. Rejecting all observations which do not conform to this criterion, also midday observations which are affected by the usual midday depression, the author compares the mean of the two series of observations by Kimball with Savélief's measures. The mean values are:

$\epsilon = 7$, Savélief $1/m = 0.647$,
Kimball $1/m = 0.786$;
$A = (1+7)^{0.647} \times 0.94 = 3.606$ (Savélief);
$A = (1+7)^{0.787} \times 0.72 = 3.698$ (Kimball).

Application of the criterion brings these otherwise discordant observations into agreement.

Sky Radiation and the Isothermal Layer: F. W. VERY.

The author describes the mechanism of heat transference and radiation absorption in the atmosphere, referring to his work on "Atmospheric Radiation," pp. 114–115 and 124. Vapors are found in the atmosphere just so long as there remains a quantity of even the least absorbing gases sufficient to preserve the temperature above the vaporization point. It was pointed out in discussing the absorbing power of gases and vapors that the absorbing power of some gases was so feeble that many miles of absorbing layers were necessary to show the spectrum lines, while other lines, notably those of water vapor, are produced by the substances in very attenuated form. Water vapor is found at the altitude of 30 km., and since temperature inversion in the atmosphere is found everywhere associated with excessive amounts of aqueous vapor, there is no reason to doubt that the great region of permanent temperature inversion, the "isothermal layer," is due to this substance. The extreme tenuity of the vapor offers no difficulty to this supposition, since the layer is many kilometers deep. I have found the great Xi bands of aqueous vapor producing almost complete extinction of the solar spectrum through a range of 3 microns, when the temperature was —30° C. This temperature is sometimes exceeded even in the isothermal layer, where also a relative humidity as high as 50 per cent. has been observed.

There are three principal loci of terrestrial radiation, namely: (1) a thin, heated, superficial layer of the terraqueous globe; (2) the solid or liquid particles suspended in the air; and (3) the upper static layer of air, called the isothermal layer, in which the permanent temperature-inversion resides. The author's supposition that elevated regions of the atmospheric, up to something like 20 km., undergo much larger temperature-variations than the more deeply situated layers of the free air, has been confirmed by Blair's observations. This phenomenon also is attributed principally to absorption by aqueous vapors.

The earth's effective temperature is not that of an elevated layer of cool air, shown on the records of the meteorological stations, but a mean in varying proportions of the three loci named, which owe their temperature to a complex of radiation, convection, absorption, cloud precipitation, etc.

The general conclusion from sky measurements is that the effective sky-temperature is lower, on the whole, when the dew-point is lower, and the aqueous obstruction of radiation to space is least; but even in the coldest and driest weather, the sky temperature has never been found lower than that of the isothermal layer, which behaves like a nearly black body of approximate temperature, $T = 218°$ Abs. C., λ max $= 13.5\,\mu$, and is opaque to most of the radiation from the solid earth of greater wave-length than this maximum.

Orbits of the Visual and Spectroscopic Binary Star Epsilon Hydræ AB: R. G. AITKEN.

The close double star known as ϵ Hydræ *AB*, discovered by Schiaparelli in 1888, is unique among the visual binary systems in that the elements of its orbit can also be deduced from the spectrographic measures of the radial velocity.

A revised system of elements from the micrometer measures, which now cover an arc of 450°, gives 15.3 years as the best value for the revolution period. Adopting this as correct, the remaining elements were computed independently from the radial velocity measures, which extend from 1899 to 1911 and include both maximum and minimum values. It was possible to find a set of elements which would satisfy both series of observations within the error of observation. These elements are: $P = 15.3$ years $= 5{,}588$ days; $T = 1900.97 =$ J.D., 2,415,375; $e = 0.65$; $\omega = 90°.0$; $i = -49°.95$; $\Omega = 104°.4$; $a = 0''.23$; $a \sin i = 493{,}000{,}000$ km.; $v = +36.78$ km.; $K = 8.45$.

From these elements we find the mean distance between the two components of ϵ Hydræ to be 1,359,000,000 km., or 9.1 astronomical units, the parallax of the system, $0''.025$ and its mass, 3.33 times the sun's mass. Seeliger has shown that the periodic variations in the micrometer measures connecting the third star *C* with the close pair

can be accounted for by the orbital motion of the binary. Assuming the effective light center of *AB* to be one seventh of the distance from *A* toward *B*, he determines the mass ratio of the binary to be $m'/m = 0.9$.

Within the next five years the radial velocity will again reach both maximum and minimum values, and spectrographic observation during this interval will be of the greatest value in determining the orbit elements more precisely.

International Standards of Wave-lengths: C. E. St. John and L. W. Ware.

This paper, which has appeared in full in the Contributions from the Mount Wilson Solar Observatory, No. 61, gives the results of the measurements of two series of plates of the iron arc spectrum, obtained with two plane grating spectrographs, one on Mt. Wilson and one in Pasadena. The precision obtained by interpolation between the international standards of the second order is 0.001 Ångstrom in the case of good lines. No errors were found in the relative wave-lengths of the secondary standards between λ5371 and λ6494 greater than 0.001 Ångstrom except for the line λ5434, where it is 0.002 Å. In this region 44 lines were found unsuitable for standards of wave-lengths on account of pressure displacements accompanied with dissymmetry. Several lines showed differences in wave-length between the two series, bearing relation to the quality of line under pressure as shown on the plates of Gale and Adams.

The Solar Rotation: J. S. Plaskett.

This paper presents the general results of a determination of the solar rotation for 1911 and a preliminary result for 1912. The values obtained at Ottawa for 1911 are well represented by the formulæ

$$v = (1.483 + 0.532 \cos^2 \phi) \cos \phi,$$
$$\xi = 10°.32 + 4°.05 \cos \phi,$$

where v is the sidereal linear velocity of the reversing layer in km. per sec., and ξ the daily sidereal angular velocity, ϕ the solar latitude. These are in remarkably good agreement with Duner's and Adams's 1908 values, except for a small angular difference constant for all latitudes. The formulæ probably represent very closely the law of variation with latitude. Measures of the same plates by different observers give systematic differences of two or three per cent., indicating that the differences noted above are probably personal, and due to the character of the lines. The discussion of some 3,000 residuals from different lines and elements show no systematic differences of velocity for different elements, or for different lines of the same element. No change greater than one per cent. is revealed in results for 1911 and 1912.

The Spectroscopic System 9 Camelopardalis: O. J. Lee.

This star was announced as a binary by Frost and Adams[6] from measures of the broad lines. They also found that the H and K lines, strong and narrow, give a variation which differs in phase and amplitude from that given by the other lines.

The observations cover about 3,000 days. The form of the velocity curve is incompatible with a simple two-body system and hence a certain form of calcium envelope has been assumed which both assists in reproducing the observed velocity curve and accounts for the difference in character of the broad lines and the calcium lines in the spectrum. The observed velocity curve is composed of three elements: the orbital velocity of the primary, the velocity of the calcium envelope about the center of the primary regarded as a stationary point, and the periodic eclipse of the spectroscopically effective parts of the envelope by the primary.

The elements of the stellar orbit are: $P = 7.9957$ days, $e = 0.30$, $\mu = 45°.024$, $K = 9.0$, $\omega = 90°$ or $270°$ closely, $T =$ J.D. 2,416,480.35, $\gamma = -2.25$ km., $i = 90°$ nearly.

Assuming that the effective calcium clouds center about the two zero velocity points, which lie one on each side of the primary $M/m = 2.85$ and $M + m = 0.0023$.

The Rotation of Jupiter's First Satellite: A. E. Douglass.

This satellite appears elliptical in form. A number of persons unacquainted with the identity of the satellites have been asked to select the one appearing elliptical. In fourteen out of seventeen trials the first has been picked out. The ellipticity is not constant, but varies on a period which does not seem to be constant. A hypothesis to account for the phenomena supposes the satellite to be an irregular body resembling an ellipsoid of three unequal axes in which the axis of figure has a considerable angle to the axis of rotation.

The Light-curve of SS Cygni from the Amherst Observations: D. P. Todd and C. J. Hudson.

Observations of this star and about 50 other

[6] *Ap. J.*, **19**, 350, 1904.

faint variables have, for the past two years, been regularly maintained with the 18-inch Clark refractor of the Amherst College Observatory. The observations are visual estimates and are accurate to tenth-magnitudes. They were much facilitated by the use of an external iris diaphragm, enabling the use of all apertures from 3 to 18 inches. The remarkable fluctuations of this star are represented on a diagram prepared by Mr. Hudson.

REPORTS OF COMMITTEES

Professor Campbell sent a written report from the Committee on Cooperation in the Measurement of Radial Velocities. The response of all the members of the committee was to the effect that though they might wish to cooperate, their instrumental resources were too weak to attack a long list of stars below the 5.0 visual magnitude where cooperation is desirable, and further, that fields of greatest usefulness for them consisted in the study of spectroscopic binaries or special groups of stars. In short, cooperation in the determination of radial velocities of extensive lists of stars fainter than the 5.0 mag. is at present impractical. The report ended with some hopeful suggestions.

The report of the Committee on Asteroids, sent by the chairman, Professor E. W. Brown, stated that the principal problems of those interested in the asteroids is to gather data for future discussion, the orbits, the light variations, etc. The first problem is the collection of the observations of position. Some organization to secure more nearly uniform observation of the many asteroids, to care for the new ones, to make certain the securing of a requisite number of early observations, to furnish an early orbit, should be perfected. An international conference on the asteroid problem is desirable.

The Committee on Comets, Professor G. C. Comstock, chairman, reported that the work of collecting data of photographic observations of Halley's comet was practically complete. The catalogue is ready for publication. The committee proposes to publish this together with the photographs secured by Mr. Ellerman at Honolulu.

Professor Schlesinger presented the report of the Committee on Photographic Astrometry. The 10-inch photographic telescope described in the last report has been mounted and put in operation. It is mounted in a constant temperature room having access to the polar region through a window of optically plane parallel glass. Exposures made from without and automatically timed on the chronograph give very exact data for determining the polar point. The methods developed for measuring and reducing the plates were described and some numerical results presented. This work will be continued at least until the spring of 1913, by which time it is expected that definite knowledge will be secured concerning the movement of the pier mounted in this way.

The financial report showed an indebtedness of about $200. Dr. John A. Brashear announced the purpose of certain Pittsburgh friends of the society to clear this indebtedness. This unprecedented generosity was gratefully acknowledged.

The report of the Committee on Teaching of Elementary Astronomy is of more general interest, so it is given in full.

Report of Committee on Cooperation in Improvement of Teaching Elementary Astronomy: C. L. DOOLITTLE, chairman. Report prepared by Miss Sarah F. Whiting.

Your committee was authorized at the Ottawa meeting to send out a circular to the observatories and colleges asking certain questions in reference to the teaching of elementary astronomy, and requesting suggestions as to methods of increasing the numbers in elementary courses, and improving the teaching.

A circular was sent out with the following preamble, to show the intent of the society:

"The Astronomical and Astrophysical Society of America states in its constitution that its purpose is the 'advancement of astronomy.'

"At its late meeting in Ottawa, Canada, it was mindful of the fact that the advancement of science depends not only on the discovery of new truth, but on the diffusion of knowledge, and the scientific spirit which creates a friendly atmosphere for its reception. The society considered the deplorable ignorance of persons, otherwise intelligent, in regard to the every-day phenomena of the sky, and the fact that astronomy lags behind the other sciences in adopting the modern method of laboratory work by the student."

Questions followed in reference to the beginning courses and methods of teaching.

Eighty replies were received, which may be considered representative, since twenty were from state universities, thirty from other universities and colleges of first rank, and thirty-two from smaller colleges and schools. Only ten reported a beginning course in astronomy extending through the academic year; thirteen reported two terms or a semester's work, and the other forty-two only

short lecture courses. Only thirty reported a regular program of evening observations, twelve some daytime exercises, ten some review of the elements of spectrum analysis as a basis for study of stellar classification, fourteen gave some library work, the rest gave only lectures with no laboratory work by the student. But two institutions, Harvard and Wellesley, reported two hours of daytime laboratory work by the students as in other sciences, and this in addition to evening work.

The numbers in the colleges electing an elementary course would be more significant if they could be reported in percentages, but this was not possible. That only eight universities and colleges reported a hundred and more in the first-year classes, three, 70–100, six, 50–70, and sixty-five mostly less than twenty-five, shows that a very small proportion of college men and women know much about anything off this little planet.

Special interest in the movement was emphatically expressed in more than half the replies, and the hope that the society can in some way bring its influence to bear to secure greater place for elementary astronomy in the programs of study, better methods of teaching elementary classes, and aid the teachers to secure better equipment and adequate assistance.

The leaders of the great research observatories, Harvard, Lick, Yerkes, Mt. Wilson, all expressed sympathy in the objects of the committee and the hope that astronomy would not long lag behind other sciences, taken up in liberal education. Several called attention to the fact that teachers of elementary astronomy should be trained as teachers of physics are trained. Colleges should be urged to understand that an observatory for the training of experts is not the entire equipment necessary for the work of a department of astronomy. Some replies, however, state the issue clearly from the standpoint of the heads of the departments of astronomy. In the choice between using the observatory for instruction or for research, the research problems have the stronger claims. As in other cases, the professor should be provided with adequate assistance.

The committee has brought the facts before the Society and calls for the assistance of the Society in constructive plans. The committee has no plan as yet formulated, but requests that it be continued.

Philip Fox,
Secretary

SOCIETIES AND ACADEMIES

THE NEW ORLEANS ACADEMY OF SCIENCE

On Tuesday, November 12, there was held at the Public Library the first regular meeting of the newly reorganized New Orleans Academy of Science. The New Orleans Academy of Science was founded in the year 1853, and was a vigorous society until the war, when its activities were suspended. It was revived again for a brief period soon after the war and then again in 1885, when it met regularly for about five years and published several volumes of transactions. Since 1890 the academy has been dormant.

As now reorganized it consists of sixteen sections with chairmen for each section as follows:

Biology and Physiology, Gustav Mann.
Botany and Bacteriology, C. W. Duval.
Zoology, George E. Beyer.
Anthropology and Ethnology, R. B. Bean.
Philology, Robert Sharp.
History and Biography, Pierce Butler.
Education, J. M. Gwinn.
Economics and Sociology, A. P. Howard.
Chemistry, Miss Ann Hero.
Geology and Mineralogy, B. V. B. Dixon.
Astronomy and Mathematics, A. B. Dinwiddie.
Geography and Meteorology, J. A. Lyon.
Engineering, W. H. P. Creighton.
Physics, H. Clo.
Philosophy, W. B. Smith.

The officers of the newly organized academy are:

President—William Benjamin Smith, professor of philosophy, Tulane University of Louisiana.

First Vice-president—Dr. Max Heller.

Second Vice-president—Dr. Isadore Dyer, dean of the medical department, Tulane University of Louisiana.

Treasurer—Dr. A. L. Metz, professor of chemistry, Tulane University of Louisiana.

Secretary—R. S. Cocks, professor of botany, Tulane University of Louisiana.

Librarian and Curator—Dr. Creighton Wellman, professor of tropical medicine and hygiene, including preventive medicine, Tulane University of Louisiana.

At the inauguration meeting there were addresses by the president and the two vice-presidents. The academy will meet hereafter the second Tuesday of each month.

R. S. Cocks,
Secretary